SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

LVIII.] NOVEMBER, 1870. [PRICE FOURPENCE, or5s. per ann. post free.

THE SQUALL OF OCTOBER 19TH.

THIS squall (to which under the title of a Tornado, some space has recently been devoted in the *Times*,) evidently merits more attention than we can at present devote to it. Strongly recommending to the attention of our readers the details of its mechanical power given in the following pages, we refrain from dwelling upon that part of the subject.

Station.	County.	Longitude.	Time of Occurrence.		
			Reported.	Computed.	Difference.
Camborne	Cornwall	5°18' W.	9 to 10 a.m.	9.30 p.m.	
Neath	Glamorgan	3 48	10.15	10.45	+30 min
Kingsbridge	Devon	3 47	11?	10.46	—14 ,,
Chepstow	Monmouth	3 41	11.15	10.51	—24 ,,
Llanwrtydd	Brecon	3 39	10.45	10.53	+ 8 ,,
Crediton	Devon	3 39	11?	10.53	— 7 ,,
Paignton	,,	3 35	11?	10.56	— 4 ,,
Lindridge	,,	3 34	11.15	10.57	—18 ,,
Westbury	Somerset	2 43	11.30	11.39	+ 9 ,,
Stratford-on-Avon	Warwick	1 43	0.15 p.m.	0.29 p.m.	+14 ,,
Cowes	Hants	1 18	0.45	0.50	+ 5 ,,
Camden Square	Middlesex	0 8	1.45	1.48	+ 3 ,,
Wood Green	,,	0 7	1 to 2?	1.49	...
Hayward's Heath	Sussex	0 6	1.50	1.50	0

We do not know the general character of storms of the type indicated by the following narratives, and we shall gladly learn where (if at all) they have been described; and in the absence of such knowledge, we feel ourselves rather groping in the dark. A glimmer if not a positive ray of light has been afforded by charting the observations hereafter recorded; and as an indication of what we wish to do, we annex a short table, the headings of which are, with one exception, self-explanatory. The exception is the column headed "Computed time of occurrence;" which has been inserted as a rough guide to the progress of the squall. The calculation is very simple; it is *assumed* that the squall was over Camborne at 9.30 a.m., and that it travelled eastwards at the rate of 1° in 50 minutes (or about 50 miles an hour);

e. g., Neath is $1\frac{1}{2}°$ east of Camborne, therefore the squall should have reached there ($1°{\cdot}5 \times 50m. = 75$) 1h. 15m. later than Camborne, namely at 10.45, which is therefore the computed time of reaching Neath, and so of the others. Considering the loose way in which the times are reported, we think the agreement so very remarkable that we refrain from further comment until next month, and hope that in the interval our numerous correspondents will turn to their registers for October 19th, and send us copies of any notes they may find recorded.

CAMBORNE.—A very heavy thunderstorm passed over here yesterday between nine and ten. a.m. The lightning was exceedingly vivid, and the rain deluging. A blacksmith's shop belonging to Mr. Holman, in Chapel-street, was struck by the lightning, and the greater part of the roof carried away. Fortunately, no person was injured.

Redruth has been visited this week by unusually heavy showers, the wind blowing strongly from the south-west. Yesterday the rain was accompanied by vivid lightning, and loud peals of thunder. Very little damage has been done. and the heavy rainfall is heartily welcomed.

SIR,—The following account from a local paper is not colored. It was an extraordinary rotary storm, very limited, but destructive, in its effects. I witnessed it at Kingsbridge. Simultaneously, there was a tidal wave of 3 or 4 feet height, at Salcombe, which lifted a sunken barge out of its bed, where it had lain for some years, and carried it some feet further off; also lifted the passage boat, with people in it, on to the rocks, and left it high and dry. Very heavy rain at the time, but only for a short time.—Very truly yours, GEO. FOX.

KINGSBRIDGE.—A destructive whirlwind swept over Kingsbridge on Wednesday morning, doing immense damage to houses, &c., in its course. The morning had been stormy throughout, and squalls of wind, with heavy showers, were frequent. About eleven o'clock, a very violent squall, accompanied by rain, which poured down as if it were one sheet of water, passed over the town, but without doing any damage except at the lower end of it, where a whirlwind swept across from West Alvington-road to Hill-side. It passed in less than a minute, during which time the wind shifted suddenly from south to north; but during that brief space of time, from twelve to fifteen houses were partially unroofed, several trees were blown down in the Retreat-field and West Alvington-road, and slates and timber flew about in all directions.

After the wind had subsided, a melancholy picture of wreck presented itself. In the turnpike road trees were lying and blocking up the passage, and just below the turnpike gate other trees, opposite Hooper's Cottages, had fallen on to the telegraph wires, which, being new and strong, did not break; but as something was bound to give way, the new large telegraph pole erected at Gallants'-bridge was broken short off, and hung in mid-air, supported by the wires crossing Mill-street. These are attached to a large pole in Mr. Tucker's garden, which although pulled out of place, did not break, and so a general wreck of the Salcombe and Brest telegraph was averted. In Union-road a house was almost totally unroofed, and at the Seven Stars Inn, a tree in Quay House grounds fell on a shed in the inn court, which it completely crushed in, shattering in its fall a gig belonging to Mr. Helmer, which had been placed underneath out of the rain. Mr. Hingston's brew-house was nearly unroofed, but the Town Mills, which stand high, and might have been expected to suffer in conseequence of greater exposure, escaped with only a few slates being lifted. The houses and stores occupied by Messrs. Hannaford, Jarvis, Boon, Lane, Grant, and Beer & Trant, were all more or less damaged—the first four very seriously—and the greater portion of their roofs

must be renewed. The wind lifted a piece of zinc—the roof of a bow window at the Ship and Plough Inn—curling it completely up, and then passing round the house, quite stripped off the whole of the plaster from the wall at the back, and scattered it over the yard. Mr. Thomas' house suffered by the roof being damaged in two places, and a chimney of the adjoining house, belonging to Mr. Beer, was thrown down from the base, fortunately falling clear of everything, into Mr. Thomas' yard. In Ebrington-street, which one would have thought sheltered, the wind was very erratic. Mr. Hammett's house was partially unroofed, and a window blown in bodily; the adjoining house escaped with but slight damage, while a few doors beyond, a great portion of Mrs. Jarvis' roof was blown off. Between these houses stands Mr. Martin's: his roof escaped, but his front door was blown out into the street. Miss Webber's house at Hill-side suffered severely; they are so damaged that probably a new roof will be required: a great hole has been made, which extends two-thirds of the length of the entire building. The violent rain had driven indoors most people, but those who were standing where they could see the effects of the wind, say the slates were flying thick in the air as a flock of birds. Timber was carried high in air, large stones were whirled about, and vehicles upset. We have not at present heard of any serious damage in the country, although at Bearscome and Shindle Mills a little has been done, and some persons who were on the roads felt the violence of the wind. Mr. H. Crimp, of South Huish, who was sheltering under a hedge, says it seemed as though the whole hedge was being lifted, and even his horse was so frightened that it was some time before he could pacify the animal.

The destructive effect seems to have been confined to a strip of country about fifty yards wide, but how long we cannot as yet tell. It was a sight such as is rarely witnessed in any but foreign countries, and one which no person would wish to see repeated.

Another Account.—A terrific squall did considerable damage in Kingsbridge yesterday morning, although lasting for only two or three minutes. It occurred at about 11 o'clock, and was confined within a radius of a quarter-of-a-mile. The Ship and Plough Hotel suffered severely, being partially unroofed and having a quantity of glass broken. A tree fell on, and knocked down, the stable of the Seven Stars Hotel, completely crushing a carriage in it. All the houses in the neighbourhood, especially in Ebrington Street, were injured, and Hillside, the residence of Miss Webber, was entirely unroofed. The greatest alarm prevailed during the few minutes of destruction. Slates were flying in the air in all directions, waggons on the quay were overthrown, the telegraph poles supporting the Brest telegraph cable snapped asunder, and trees in the West Alvington Road rooted up and blown into the road, causing the temporary suspension of traffic. It is estimated that damage has been done in the south of Kingsbridge to the extent of several hundreds of pounds.

A violent storm of wind and rain visited the neighbourhood of Paignton yesterday morning at about eleven o'clock. The rain was heavier than has been seen for a long time. No casualties of moment occurred, except that the shop front of Mr. Marley, draper, Church-street, was blown in, and slates and thatch were removed from several houses,

To the Editor of the Meteorological Magazine.

SIR,—The tornado which reached Stratford-on-Avon at 12·15 on the 19th October (*Times*, 24th October), passed here at 11.15 exactly. After taking down some large elms at Hardwick, on the Monmouthshire side of the Wye, it disabled some exposed trees in the open, about half a mile to the S.E. of this; when crossing a narrow lane it was encountered by a close orchard of about 250 yards square. Within this orchard some 30 or 40 trees lie prostrate, all their roots and soil facing the south, as also the elms in the hedges surrounding it; one large tree at the north end resisting, has its trunk twisted and burst open from near

the ground upwards; two firs standing about 18 feet, like broken masts. The inhabitants of a house in the open, on each side of which it rushed, and near the disabled trees, are said to have felt the house itself as twisting. It is said to have come from Cardiff and Neath, and to have been there at 10.15.—Yours, RICHARD PEAKE.

Wirewoods' Green, Chepstow, October 25th, 1870.

LLANWRTYD.—*To the Editor of the Times.* SIR,—I have read Mr. Morford's letter with much interest, and am induced to send you an account of what I witnessed on the same day. On the morning of the day named, the 19th, I rode, in the midst of blinding wind and rain, to see some men that were working near a wood at Llanwrtyd, Breconshire. I found that the men had been driven to seek shelter from the rain, and I was induced by them to shelter also for a few minutes before entering the wood. While we were thus standing together, a sudden irresistible blast passed up the valley, and, almost simultaneously, 11 oak trees fell to the ground before us, uprooted. There was no swaying of the branches, but the trees fell just as bare poles would fall. The noise of the storm, hitherto raging, seemed hushed for the moment, and a low whistling sound was all that I heard. The time was, as nearly as possible, a quarter before 11, and the trees all fell within three seconds, and alike in the same direction, west to east. Llanwrtyd is about 80 or 90 miles due west of Stratford-on-Avon, and the storm thus described was probably that which reached Shakespeare's birthplace an hour later.—I am, Sir, your obedient servant, *John Lloyd. Jun.*, Huntington Court, Hereford, Oct. 25.

CREDITON.—Yesterday morning at about eleven o'clock, a whirlwind passed over the extreme western part of the town, causing considerable damage in the locality. About 40 feet of walling were blown down in the garden of the Grammar School, and nearly an equal amount of damage was done to Mr. Berry's garden. Elm and apple trees suffered much, and one of the western roads was rendered impassable by the branches of trees. Several chimney stacks were knocked down by the terrific force of the wind. Mr. John Long, who lives in a newly-built house at Threshers, being an invalid, had but just risen from his bed, when an immense mass of bricks from the chimney fell through the roof on the bed. The force of the storm, which lasted only a few minutes, was not by any means so great in other parts of the town. Very heavy rain fell before and after the whirlwind,

LINDRIDGE.—*To the Editor of the Times.* SIR,—It may interest some of your readers to know that a tornado similar to that described by Mr. Morford in your paper of the 23rd inst. passed over this neighbourhood on the same day (Wednesday, 19th), about 11.15 a.m., at which time it struck my house, situate about twelve miles S.W. of Exeter, and four miles from the coast, blowing in some glass of the windows with great violence. Its duration was about three minutes, and its course was marked by the devastation caused among the timber, one elm in particular, 14ft. in girth, having been snapped off at about 15 ft. from the base. The area of extreme force of wind did not appear to exceed 200 paces in width. I understand it visited the town of Kingsbridge, causing considerable damage. I remain, Sir, your obedient servant, *J. G. Templer*, Lindridge, Oct. 26.

WESTBURY.—*To the Editor of the Times.* SIR,—The tornado mentioned by a correspondent in the *Times* of to-day, passed over, or rather through, this village (Westbury, near Wells, Somerset) on Wednesday last, about half-past 11 a.m., doing considerable damage. Its force was confined to a space of about 100 yards wide, its direction was from the west. The air, for about a minute, was filled with earth, leaves, &c.; many trees were blown down, some stripped of leaves and branches; the roofs of several buildings destroyed, ricks half blown away; two galvanized iron sheep-troughs, 12 feet long, in a field in front of my house, were first turned upside down, and the wind then catching them up, one was deposited safely on my lawn, having cleared a sunk fence wall 4 feet high; the other, not so fortunate, caught an angle, and was doubled round it like a strip of linen or paper, where it stuck. The cast iron wheels were snapped off, one being found in the yard attached to the house, and to get there it must either have passed over a gate

which was not in its direct course, or over a wall 9 feet high, which was. The course of the wind was towards Chewton Mendip, where it is said to have done damage; but the chief injury in this neighbourhood was in this village, but only through a space of about the width mentioned.—I am, Sir, yours obediently,
Oct. 24. T. K. T.

STRATFORD-ON-AVON.—*To the Editor of the Times.* — SIR,— At the risk of troubling you with what may seem to many a matter of slight importance, I take the liberty of communicating to you an item of intelligence which seems not to have been forwarded to the press by any other observer.

Some mention has been made of the fact that a severe gale, of brief duration, swept over certain portions of the south of England about noon on Wednesday last, the 19th, supplementary to the heavy gales of less immediate violence, but longer duration, which had, during the previous week, prevailed on the Channel and at different points along the coast, doing extensive damage and causing considerable loss of life. It is within my knowledge, however, that at least at one point in midland England, not only was any violence of that gale, otherwise recorded, fully equalled, but that the rare spectacle, for the British Islands, of an actual tornado was witnessed in, perhaps, the most notable spot in all these islands.

At about a quarter-past 12 that day, I was within the vestry-room of the old Church of the Holy Trinity at Stratford-on-Avon, examining, with a party of friends, the birth and burial records of Shakespeare, whose remains are well known to lie under the chancel pavement of that church. A heavy dash of rain had been heard against the windows and on the roof, and the wind was observed to be blowing with a certain degree of violence. But suddenly the violence of the wind seemed to be increased a hundred-fold; its pressure against the great stained glass window of the vestry-room (filling the end of the cross immediately abutting on the Avon), cracked the glass and sent it flying in splinters into the vestry, with serious prospect that the whole window would be crushed in like so much pasteboard; the entire portion of the church seemed to rock and sway, leading to grave momentary doubt whether at least all that portion of the doubly-sacred old pile would not be overthrown, at the same time that the solemnity and terror of the moment were added to by the almost total absence of the light of day.

This extreme violence of the wind lasted, providentially, but for perhaps two or three minutes, though the gale did not waste itself for fully half-an-hour.

Examination made immediately afterwards showed that several of the great elms standing on the Avon bank had been wholly or partially destroyed—branches wrenched from trunks and trunks overthrown, and one magnificent tree, not less than 15 inches in diameter, snapped like a reed at some 10 ft. from the ground; while iron railings and their stone foundations had been wrenched from their places, monuments damaged, and a sad though limited scene of ruin presented to the few who were at once fortunate and unfortunate enough to be present.

That the violence of the wind, pressing against the window itself, broke the glass, and threatened so much worse consequences than actually ensued, and that the damage did not result (as some allege) from pieces of the broken trees being hurled against the panes, will be realized by those who know that this window, like that of the Shakespeare Birth-room, in Henley-street, is completely covered by close wire-netting, making such a blow from branches impossible.

After-observations, crossing Warwickshire towards Warwick and Leamington, showed trees somewhat damaged, but no traces of so much violence of the wind expended in any other spot than that around which clusters so much of the best reverence of Englishmen and the world.—I am, Sir, yours obediently, *H. Morford*, Langham Hotel, October 21.

COWES, I.W.—*To the Editor of the Times.* SIR,—It will doubtless interest many of your readers to know that on the 19th inst., the day mentioned in Mr. Morford's letter, in *The Times* of the 24th inst., a very violent gust of wind swept over the north point of the Isle of Wight. Mr. Morford states he observed the tornado at Stratford-on-Avon, at about a quarter-past 12, while here the intense gust passed at about a quarter to 1 p.m., or about half-an-hour later. The *maximum* force lasted but about five minutes, but in that time it did very

considerable damage to houses, chimney stacks, and trees that lay in its narrow path. An anemometer, nearly in the centre of its path, recorded the extraordinary pressure of 30lb. on the square foot.—I am, Sir, your obedient servant, J. R. M., Cowes, Isle of Wight, October 25th.

CAMDEN SQUARE.—Very sharp squall, with heavy rain, between 1.45 and 1.53 p.m.; 0·10 in. of rain fell in that time.

WOOD GREEN.— On Wednesday a severe hurricane passed over Wood Green, causing considerable damage. The pianoforte manufactory of Mr. Ivory, adjoining the railway, is a building of four stories in height, the roof of which was completely blown off, exposing the machinery and damaging seriously the ceiling and brickwork of the third storey. When this happened the proprietor and men were at dinner*, thus fortunately averting loss of life. A tree in front of Mr. Hollingsworth's house was limbed, one branch falling upon the carriage-house, upon which not a tile remained. An unfinished house opposite the pianoforte manufactory had all its back windows blown out, and all the sheds in the vicinity of this building lost some of their tiles or slates. In Lordship-lane considerable damage was also done to the trees. In a field opposite the "Nag's Head" stood a hay-stack, the thatching of which was all blown off, and the hurdles surrounding it blown in all directions. A magnificent willow which stood in front of Mr. Minnett's house in Lordship-lane, now presents an unsightly appearance; the greater part of its trunk has been broken off, and the upper part limbed. The field adjoining this house was strewed with small limbs of trees. At No. 1, Lindum-villas, the chimneys were broken off on a level with the roof, and blown down on the house. The hurricane seemed to have swept over in a straight line, beginning at the pianoforte manufactory, and ending its career in Lordship-lane. No damage seemed to have been done elsewhere but in the line indicated.†—*North Londoner*, October 22.

To the Editor of the Meteorological Magazine.

SIR,—The barometer here has been falling steadily since yesterday morning, with a special exception this afternoon. My readings for the day are—

7.50 a.m.	29·50
1.15 p.m.	29·38
1.30 p.m.	29·34
1.45 p.m.	29·32
2 p.m.	29·38
7 p.m.	29·33
8.30 p.m.	29·29

I was much struck with the rapid fall from 1.15 to 1.45 p.m. At 1.50 a violent squall with a very heavy rain passed over us, blowing down a wall, and by 2 p.m. it was gone, and the weather clearing.

The barometer is now falling again, the wind rising, and the weather looking threatening.

You may, perhaps, feel interested in this squall. The wind was south. My barometer has a wood scale; height above sea, 200 feet. Temperature, 55°.—Yours very faithfully,

THOMAS CRALLAN.

Hayward's Heath, Oct. 19th, 1870, 8.30 *p.m.*

[We shall be glad to receive further details of this storm, and should wish them to reach us by the 28th inst.—ED.]

---

* Therefore it probably occurred between 1 and 2 p.m.

† This would be about from W. to E.

THE AURORÆ OF OCTOBER 24TH & 25TH.

IN spite of ridiculous assumptions of the omniscience of the editorial *we*, there probably lives not an editor who does not feel that in spite of all his efforts he has not done full justice to many a subject which comes before him. We own to such a feeling with respect to the recent auroral displays. We have endeavoured to select from the mass of communications (with which we have been favoured) those which were most usefully descriptive, and we have doubled the size of our Magazine in order to insert them; but, after all, the delicate softness of many of the tints remain simply in memory's eye, for none can reproduce them, either verbally or by the brush; and the height and position of that glorious band are, as yet, undetermined. We hope that others more favourably situated than ourselves (in a Great Western express) have noted the positions of the streamers with sufficient accuracy to determine their height. Our only *exact* observations on the 24th, were:—At 8h. 18m. 50s., when between Twyford and Taplow, we noticed a white streamer shot vertically between Mizar and Alioth, Ursæ Majoris, and at 8h. 34m. 5s., between Langley and West Drayton, a red one, also nearly vertical, passed over the constellation Lacerta.

MALTA.—Last night (the 24th) there occurred a strong red light in the sky between 7 and 8 o'clock. Naval friends told me of this, and of their doubts as to whether it was an aurora borealis or an eruption of Etna, which would be visible from this place. This evening the light was far stronger, and I was able to observe it. It commenced very soon after dark, about 6.30, and at the time I am writing (9 p.m., 25th) there is but the faintest tinge of the light left. I obtained access, with some friends, to the top of the house, which is very lofty, and, from my view thence, I have little doubt it was an aurora borealis, as two rays were to be made out. The light was directly north as its centre, of a brick-dust red (it has been very hazy all day, and is so now). The people here are in much amazement; most believe in a great eruption of Etna; hence it is obviously very seldom that such a sight is seen here, and that it should occur two nights running surprises those who know the aurora borealis. If it be that, it has, no doubt, occurred with uncommon brilliancy in England, and it may be interesting to know that it has been seen here, so far south.—*R. H. Fawcett.*

NEWPORT, ISLE OF WIGHT.—This evening (October 24th), shortly after 8, I witnessed the grandest display of Northern Lights which has occurred here within the memory of persons of quite an advanced age, if not within that of the "oldest inhabitant." In the N.E. and W. the sky had the appearance of a distant conflagration, the usual tint being supplanted by a bright red. In the N. and near the horizon, its colour was pale green. At one time I remarked a band of primrose, or sulphur-hued, streamers in the vicinity of the pole star, flanked by others of a fiery red appearance. By 8.30, the heavens had regained much of their usual aspect. Barometer, 29·41 inch; temperature about 48°. The weather lately has been exceedingly stormy, and 4·35 inches of rain have fallen this month.—*E. G. Aldridge.*

CYNTHIA VILLA OBSERVATORY, WALTHAMSTOW.—A very fine aurora was visible here on the evening of October 24th (Monday), 1870, between 8 and 9 p.m. The peculiar magnetic or auroral light in the magnetic north was very vivid. I observed numerous auroral clouds (if the term may be permitted) deeply tinged with red, strikingly in contrast with the light in the north, in various parts of the heavens, particularly one a little south of the prime vertical, which covered the constellation Taurus, the light of the stars appearing as if impeded by a slight fog or mist.—*W. R. Birt.*

WINCHMORE HILL.—Most magnificent displays of aurora borealis were observed here last night and to-night. At 7 p.m. last night (24th), a bank of white light, extending from N. to W., rose to about 20°. At 8 p.m., an arch of brilliant red light stretched across the sky from N.N.E. to W.S.W., and pale waves of light rolled across the sky almost to the southern horizon, which continued till 8.30, when it faded away. At 11.15 p.m., it again became very bright. To-night the display was almost finer than that of last night. At 6.30 p.m., the whole sky was covered with a brilliant red light; streamers from all points of the horizon converging to a centre right overhead, presenting the appearance of a dome of fire. At 7.30, the sky unfortunately became cloudy in the west and north. Streamers were visible through the clouds, and the sky in the east and south continued tinged with deep red till 9 p m., when it became completely overcast. The light on both nights was almost as strong as that of the moon.—*Thos. Paulin.*

ORLETON.—The appearance of the aurora borealis on the 24th and 25th was very brilliant. The barometer, which had been very low the whole of the 23rd, began to rise very gradually on the 24th. After sunset there were a few dusky drifting clouds, with a brisk wind, but the sky was generally clear, and the north-western half was filled with a bright, diffused, auroral light, very red in the N.E. and W.S.W. Gradually deepening in these points and fading in the N.W. till about 8 p.m., when masses of rosy streamers shot up to the S.E. of the zenith, forming at times a bight corona, with one of the stars in Cassiopia nearly in the centre. This brilliant appearance continued, with rapid changes, for about 15 minutes, after which it gradually faded away, with much diffused light and occasional streamers till midnight. On the 25th, at a quarter before 6 p.m., the sky was again generally clear, with the same bright light in E.N.E. and S.S.W., and streamers to the zenith; but the arch formed by these was farther to the south-east than the one on the 24th, and the north-western part of the sky was more faintly illuminated. For 15 minutes the corona and streamers were very beautiful, but not so deep in colour as on the 24th, shooting up from the southern half more than from the northern half of the sky, and meeting to the S.E. of the zenith, at times like the ribs of a vast umbrella. After 6 p.m., the streamers began to fade into a steady diffused light, but they re-appeared occasionally from the N.W. till 10 p.m.—*Thos. Hy. Davis.*

SUTTERTON, SPALDING.—Fine aurora here last evening (25th). From six to seven p.m. the whole sky suffused with a lurid red tint. The appearance at this time very remarkable, owing to the mingling of what seemed to be cirro cumulus clouds with the auroral light. About 8 p.m., the phenomenon assumed the ordinary appearance of an irregular arc of light in N., resting on smoky-looking clouds below, and sending streamers from the upper edge, which reached up to, and beyond, the zenith. Gradually faded after 10 p.m. A remarkable feature was the continuance of great isolated masses of light in S. and S.W. after the main body of the aurora had become concentrated above the northern horizon.—*G. T. Ryves.*

WOLVERHAMPTON.—A few words about the aurora. The first day's display was, undoubtedly, the grandest, so far as the magnificent arch, which formed here about 8.10, and lasted, more or less perfect, for about 20 minutes; but, to my mind, the second evening's display was the most interesting. It began soon after sunset, and, from about 6 till nearly 10, was very beautiful. At no time was an arch completely formed, but in the zenith, or rather, about five degrees to the S.W. of the zenith, a most singular appearance was presented. It resembled the wing of a bird, the thick end being to the S.W. and streamers continually issuing from it in all directions except the S. and S.W. These streamers appeared to be met by other streamers issuing from banks of light cloud on the horizon. The incessant change of position and colour of the streamers was almost bewildering, and very beautiful to behold.—*John Thrustans.*

HAWSKER.—I shall not attempt to describe the indescribable aurora of the 25th, but there were some very unusual features about it which demand notice. In the first place, at 7 p.m. there was little to be seen in N., but an intense dark crimson in E. and S. At 9 p.m. there were white streamers (not corruscating) in N., but

the magnificent display was overhead. In the constellation of Andromeda there was a central point from which the rays, partly white and luminous, partly of the most beautiful and bright crimson, diverged to N. and E., partly to S., but principally to W. These appearances seemed to indicate that the aurora would be seen over a large area and very far to the south, which was actually the case.—*Fenwick W. Stow.*

SUNDERLAND.—The intense redness of the aurora of the 24th was most remarkable. I looked at its spectrum, and found that a red line, which is always visible in the spectrum of red auroræ, was unusually bright in the reddest parts, but in no part of the aurora, so far as I observed, did it exceed in brightness the yellowish-green line, which is characteristic of all auroræ. Besides these two lines, three fainter and more refrangible bands were visible. This magnificent aurora lasted throughout the night of the 24th, and the greater part of the next night.—*T. W. Backhouse.*

WREXHAM, NORTH WALES.—A most splendid aurora borealis was seen here last night, October 24th. Its greatest brilliancy was about 8 p.m., when the whole heaven, from N.E. through N. to W., was illuminated, the colours changing from a deep rose to orange and green, the last-named being especially noticeable towards the W. A perfect boreal crown appeared a little S.E. of the zenith, with pale streamers radiating to the brilliant arch of colour above mentioned. This is the finest aurora I have ever seen in this latitude. The wind at the time was N.W., fresh; barometer rising.—*Boscawen T. Griffith.*

MENAIFRON, CAERNARVON.—Soon after 8 p.m. on the night of October 24th, my attention was drawn to an extraordinary appearance of the sky, the greater part of which was of a blood-red colour. On closer examination, I found that streamers of a yellower hue shot across the red, radiating from a central point overhead, a little south of the zenith; these latter reaching, in places, down to the horizon, more especially towards east and west. The stars were visible through the reddest part, excepting where occasional heavy clouds, whose edges were, however, tinged with the prevailing tint, intervened. The wind was W.N.W. at the time, and blowing in heavy squalls. Barometer low (28·613), but rising; thermometer attached, 56°. The appearance continued about half-an-hour, when it gradually became fainter and finally disappeared. A similar sight was witnessed, but not by me, on the night of October 14th; and in a lesser degree on the nights of October 16th, 19th, and 21st. Three heavy gales and strong breezes occurred within that time.—*W. Wynn Williams.*

BLOOMSBURY, MOUNT ANVILLE, CO. DUBLIN. At about 7.40 p.m. (24th), the whole sky, from about S. by E. to S.E. by S. (northerly), was brilliantly illuminated, the brightest part being from E.S.E. to E.N.E., which appeared as a cloud of a fiery orange hue; also the same colour of a lighter shade to the S W., the southern edges of both clouds lightening into the usual colour of the sky; the interval towards the north being filled with streamers of white, culminating in a ragged cloud, slightly to the S. and E. of the zenith. During a portion of the time the aurora was visible (which was not more than ten minutes from the time I first saw it) there was a horizontal flickering of white light from about 70° to the zenith. At the time of the appearance the barometer stood at 29·22 (rising), thermometer 44°, wind W.N.W.—*J. Wensley Bond.* P.S.—I have since heard that the aurora was visible from 6 p.m., but I did not see it.—J. W. B.

THE BRITISH ASSOCIATION AT LIVERPOOL.

(*Concluded from p.* 139.)

Rainfall of the United States. By Professor HENRY.—Professor Henry gave an extremely interesting account of the steps which he has taken to collect and discuss the observations of rainfall made in the United States. As we hope on an early occasion to be able to refer to the matter more fully, we will merely state that he has for some time past had a staff of six or seven computers engaged in collecting and discussing all the observations hitherto made in the States, and

that charts showing the results thence deduced are nearly ready for publication. Professor Henry also explained the steps which he was taking (by the issue of identical instruments to be placed uniformly) to ensure improved accuracy in future observations.

On Barometric Predictions of Weather. By Mr. GALTON.—The barometer corresponds, not with the tumultuous changes of the weather, but with those of its average quality. Numerous trials showed the period of time for which the averages should be taken to be about twelve hours; and the correspondence of a curve drawn on that principle with the barogram was fairly satisfactory. The flexures of the two curves are, on the whole, simultaneous, since neither curve habitually anticipates the other, but seldom absolutely simultaneous. They correspond in extreme positions as closely as in near ones, proving that it is not the absolute height of the barometer, but the variation in its successive heights, which indicates change of weather. The superior influence of the wind upon the barometer over both temperature and damp was remarkably apparent by the help of these curves. Lastly, the influences of temperature and damp were shown to conform to the already described period of twelve-hour averages. A simple formula for the prediction of weather for the next six hours was constructed upon these data. It included (1) the difference between the first and second of two barometric readings taken six hours apart; (2) that between the average wind velocity during two periods (which we may call c and a) of six hours each, c succeeding the last barometric reading, and a preceding the first reading, the intermediate period b necessarily disappearing from the formula; (3) half the difference between the average temperatures during c and a; (4) the same as regards vapour tensions. Then, it was shown that (1) was equal to the term of the remainder when the barometer and vapour tension are reckoned in hundredths of an inch, the velocity in miles per hour, and the temperature in degrees Fahrenheit. A calculation was made with the above formula to determine the average velocity of the wind for a large number of six-hour periods, and the predictions were compared with the facts. It was found that the average error of the predictions was one-third larger than if the observer had simply guessed that the average wind velocity would continue unaltered for the next six hours. The reason why the errors are so large is, first, that correctness in the result depends on the correctness of all the elements of the formula, but the values of these are only true on the average, while in each particular and in each case there will be more or less deviation from that average; secondly, any error in the expectation of the twelve-hour average is, on the whole, doubled in the six-hour prediction, because the difference between what is expected of the whole and what was fulfilled in the first half of it, is heaped on to the second half, which has therefore to bear an additional error, equal to what rightly belongs to it. The fame of the barometer is due to its success in predicting a type of storm very rarely met with in the British Isles, but frequently in hurricane latitudes, when the fall of the mercury far outstrips the increasing severity of the weather. In ordinary gales, and much more in ordinary weather, the author considered the barometer to be useless as a guide, when consulted without a knowledge of what is occurring at adjacent stations; in short, without such information as is supplied by the "Daily Weather Report."

On Atmospheric Currents. By Mr. J. K. LAUGHTON.—In examining into the geographical distribution of winds, we must bear in mind that well-attested and careful observation is the only satisfactory basis, and that descriptions founded on theoretical opinions are of no value whatever. If we refer Hadley's Theory of the Trade Winds to this test, we find, in the first place, that the effect of heat in producing wind is not quite such as has been represented. Experimentally, heat does not produce a blast, unless the space between the heat and cold air be very confined, as is roughly shown by holding a newspaper before the fire. Geographically, heat does not cause a wind towards any of the principal areas of greatest temperature; either towards the Great African Desert, the Desert of Arabia, or of Australia, towards the Red Sea or the Persian Gulf, or even, when carefully traced, towards the Great Prairie of North America. In the second place, we

find that the effect attributed to the rotation of the earth is not consistent with numerous observed facts, such as the S.E. wind in the Gulf of Mexico, the N.W. wind on the coast of North Africa, the N.W. gales in the North Atlantic, the S.W. wind on the south coast of Australia, and very many others; and, indeed, the idea appears to have originated in a temporary forgetfulness of the power of friction, which in the case of air and all fluids is very intense.

Winds, which, in accordance with Hadley's theory, have been very generally divided into *polar* and *equatorial*, seem more naturally to divide themselves into *easterly* and *westerly*; and it is this division which has, from the days of Columbus, been adopted by really practical men, to whom the winds were matters of fact, not of mere theory; but the trade-winds—having attracted early notice by their very great steadiness and regularity—have always been considered as the direct manifestations of the first cause, whatever it might be, of the great atmospheric movements; the westerly winds, which were not discovered till much later, having been considered as secondary and comparatively of little importance. But, as our experience grows larger, we learn that the westerly winds have an extent and a strength and a rude vigour incompatible with the idea of their secondary nature. Whether in the northern or southern hemisphere, they are exceedingly violent and boisterous; and, without considering the Arctic and Antarctic regions, concerning which we have not sufficient evidence, they extend from 60° N. to 60° S., interrupted only by the trade-winds, which blow over an area large indeed, but small *in comparison* with that on which they intrude. The trade-winds are also of very limited height, whilst above them the westerly winds blow as strongly as they do in the temperate zones, where they reach into the upper strata of the atmosphere as far as we have any knowledge. We are thus led towards the conclusion that the westerly winds are really the primary winds, far extending and boisterous; whilst the quiet equable trade-winds—of very limited volume—are reflex streams of air caused by the impact of the great westerly winds on the continental barriers, whether against mountain ranges or the more sluggish air which lies over the land. The Atlantic Ocean affords us the most familiar illustrations of this; where we see the main westerly stream dividing on about the parallel of 45° N., and turning north, as a south-westerly wind on our coasts, and the coast of Norway; or south, as a north-west and northerly wind on the coast of Portugal, and a north-easterly on the coast of Africa; whilst the rest of it forces its way onward, a westerly wind over Northern Europe and Asia, or a northerly deflection in the several basins of the Mediterranean. On the other hand, on the extreme west, the westerly wind continually dragging away the air from the eastern side of the Rocky Mountains, causes such a tendency towards a vacuum, that the air from the south and north is induced towards it, and the wind over Western America rules from the south or north, according as the season throws the axial line of the temperate zone to the north or south of its mean position. Examining at great length into the various local winds and irregularities in the different parts of the world, we arrive at the conclusion that the whole atmosphere has a continued tendency to move from west to east, and does so more when it is not interrupted. The interruptions are of two kinds: one occasional and irregular, being caused by fluctuations in the hydrostatic condition of the air, the other permanent or seasonal and regular, caused by the pressure of lines of coast and mountain ranges.

It is impossible to say definitely why the atmosphere should have this prevailing motion; but if the cause is neither heat nor the influence of the earth's rotation, nor any agency which we can detect at work on the earth, we are driven almost insensibly to the belief that it must be the result of celestial attraction; and the fact that the barometer shows no trace of any noteworthy rise or fall, as of an atmospheric tide, suggests that the atmospheric currents, which must necessarily be formed by the action of such an intense disturbing force, do not in any way clash, but flow uninterruptedly onwards in one certain direction, either towards the east or towards the west. All observation shows us that there is not a permanent current towards the west, but that there is one towards the east; and although we are unable at present to master all the details of the manner of the motion, the evidence of geographical fact, combined with that of astronomical possibility,

justifies us in inclining towards the belief that the motive force for which we are seeking is really the disturbing force of the attraction of the heavenly bodies.

Third Report of Underground Temperature Committee. — This was read by Professor J. D. Everett, the Secretary of the Committee. — Mr. G. J. Symons, whose observations, extending to a depth of 1,100 feet in a well at Kentish Town, were reported at last meeting, has since repeated his observations at several depths.

The first 210 feet of the well (which is eight feet in diameter to the depth of 540 feet) are occupied by air, and in this portion of the well the second series of observations give temperatures exceeding those observed in the first series by from 2° to 5°, the excess diminishing as the depth increases. The second series were taken in July and August, whereas the first series were taken in January. It is evident that, in this portion of the well, in spite of the precautions taken to exclude atmospheric influences, by boarding over the well and erecting a hut over it, the temperature varies with the seasons, the variations being in the same direction as in the external air, but smaller. and diminishing as the depth increases, but still amounting to 2°·2 at the depth of 200 feet.

We can feel no certainty that even the mean annual temperature in this portion of the well represents the temperature in the solid ground. On the contrary, the mean temperature in the well at any depth is probably intermediate between the temperature of the solid ground at that depth and the mean temperature of the external air.

It is well that such observations should have been carefully made and recorded in this one instance, if only for the sake of warning ; and they show that we cannot expect to attain the object for which the Committee has been appointed by observations in large shafts filled wth air.

Mr. Symons has also repeated the observations at 250 feet (which is 40 feet under water), and at the depths of 600 feet, 750 feet, and every fiftieth foot from this to 1,100 feet, which is the lowest point attainable on accounnt of the mud, which extends 300 feet lower. The differences from the results obtained last year are +·2, —·3, —·4, —·2, — ·2, 0, —·1, —·1, 0; which, upon the whole, strongly confirms the correctness of the observations.

The temperature at 1,100 feet is 69·8, which, if we assume the mean temperature of the surface of the ground to be $\left\{\begin{matrix}50°\\49°\end{matrix}\right\}$, gives a mean increase downwards of $\left\{\begin{matrix}·0180\\·0189\end{matrix}\right\}$ of a degree Fahrenheit per foot, or 1° for $\left\{\begin{matrix}55·5\\52·9\end{matrix}\right\}$ feet.

The curve in which temperature is the ordinate and depth the abscissa, exhibits considerable irregularities till we reach the depth of 650 feet, beyond which it is nearly a straight line, and represents an increase of ·0187 of a degree per foot.

The strata penetrated by the well to the depth towhich our observations extend, consist of clay, sand, chalk, and marl, besides flints. (See tabular list appended.)*

Mr. Symons, in his report, calls attention to the anomalous position of a column of water, increasing in temperature and, consequently, diminishing in specific gravity downwards, and suggests the inquiry why the warmer and lighter portions do not ascend to the top? The proper reply seems to be that the diminution of specific gravity, amounting to less than one part in 50,000 per vertical foot, does not furnish sufficient force to overcome liquid adhesion, and the water is thus able to remain in unstable equilibrium.

Mr. Symons intends during the remainder of the present year, verifying those of his observations which have not yet been repeated, and concludes his report by remarking that it appears desirable to ascertain by observations from year to year, whether the temperature at a given depth (say 1,000 feet) remains constant or is subject to minute changes, periodical or otherwise—a suggestion which appears fully worthy of being carried out.

Mr. Wm. Bryham, manager of Rosebridge Colliery, Ince, near Wigan, has taken very valuable observations during the sinking of that colliery, which is now the deepest excavation in Great Britain. The principal results have already been

* This was given in *Met. Mag.*, Vol. III., p. 176.

given in a paper to the Royal Society by Mr. Edward Hull, director of the Geological Survey of Ireland, who had previously published some important contributions to our knowledge of underground temperature; and has now consented to become a member of this committee. Some of the depths have, however, been re-measured since Mr. Hull's paper was read, and we are now enabled, through the kindness of Mr. Bryham, to furnish a rather a rather more accurate report.

The temperatures observed, and the depths at which they were taken, are as follows :—

Depth in yards.	Temp. Fahr.	Depth in yards.	Temp. Fahr.
161	(64½)	734	88½
200	(66)	745	89
558	78	761	90½
605	80	775	91½
630	83	783	92
663	85	800	93
671	86	806	93½
679	87	815	94

All these temperatures, except the first two, were observed during the sinking of the shaft, by drilling a hole with water, to the depth of a yard, in the solid strata at the bottom. A thermometer was then inserted, the hole was tightly plugged with clay so as be air-tight, and was left undisturbed for half-an-hour, at the end of which time the thermometer was withdrawn and read—a mode of observation which appears well adapted to give reliable results. With respect to the temperatures at 161 and 200 yards (which are enclosed in brackets to indicate uncertainty), Mr. Bryham says that he has some doubt as to the correctness of the thermometer with which they were taken, and that they were not taken in the shaft at the time it was sunk, but in the seams at the depths named.

Assuming the surface temperature to be 49°, we have, on the whole depth of 815 yards, or 2,445 feet, an increase of 45°, which is at the rate of ·0184 of a degree per foot, or a degree for every 54·3 feet.

On plotting the temperature curve, including the two observations marked as doubtful, we find that it naturally divides itself into four portions, which are approximately straight lines.

The most remarkable of these portions is the second from the top, extending from the depth of 161 yards to that of 605 yards. It embraces 1,332 feet, and shows an increase of only 1° for every 86 feet.

The third portion, extending from the depth of 605 yards to that of 671 yards, covers only 198 feet, and shows an increase of 1° for every 33 feet.

The lowest portion extends from the depth of 671 yards to 815 yards. It covers 432 feet, and shows an increase of 1° in 54 feet.

The topmost portion will be affected by the assumption we make as to surface temperature. Assuming this as 49°, it shows an increase of 1° in 31 feet.

It is interesting to compare the Rosebridge observations with those previously made by Mr. Fairbairn at Astley Pit, Dukinfield, Cheshire, which have been described by Mr. Hull in "The Coalfields of Great Britain," and by Mr. Fairbairn himself in the B. A. Report for 1861. The results have been thus summed up by Mr. Hull :—

1. The first observation gives 51° as the invariable temperature throughout the year at the depth of 17 feet. Between 231 yards and 270 yards the temperature was nearly uniform at 58·0. And the increase from the surface would be at the rate of 1° F. for 88 feet.
2. Between 270 and 309 yards, the increase was at the rate of 1° for 62·4 feet.
3. ,, 309 and 419 ,, ,, ,, 1° for 60 ,,
4. ,, 419 and 613 ,, ,, ,, 1° for 86·91 ,,
5. ,, 613 and 685 ,, ,, ,, 1° for 65·6 ,,

The result of the whole series of observations gives an increase of 1° for every 83·2 feet.

Mr. Fairbairn's own summary is as follows:—"The amount of increase indicated in these experiments is from from 51° to 57¾°, as the depth increases from 5⅔ yards

to 231 yards, or an increase of 1° in 99 feet. But if we take the results which are more reliable, namely, those between the depths of 231 and 685 yards, we have an increase of temperature from 57¾° to 75½°, or 17¾° Fahrenheit. That is a mean increase of 1° in 76·8 feet."

Mr. Fairbairn here, by implication, throws doubt on the alleged invariable temperature of 51° at the depth of 17 feet, a determination which, in itself, appears highly improbable, seeing that at Greenwich the thermometer, whose bulb is buried at a depth of 25·6 feet, exhibits an annual range of 3°·2, while that at the depth of 12·8 feet exhibits a range of 9°. But even if we assume the mean surface temperature to be 49°, we have still upon the whole depth an increase at the rate of 1° in 80 feet, as against 1° in 54·3 feet at Rosebridge.

Mr. Fairbairn's paper gives also the results obtained at a second pit at Dukinfield, which agree with those in the first in showing an exceptionally slow rate of increase downwards. The temperatures at the depths of 167½ yards and 467 yards were respectively 58° and 66½°, showing a difference of 8½° in 299½ yards, which is at the rate of 1° in 106 feet. The increase from the surface down to 167½ yards, assuming the surface temperature as 49°, would be 9°, or 1° in 56 feet, and the mean rate of increase from the surface to the bottom would be 1° in 80 feet, the same as in the first pit.

A tabular list of the strata at Rosebridge is appended to this report. A full account of the strata at Dukinfield is given in Mr. Fairbairn's paper (B. A. Report, 1861).

With strata so nearly similar and in two neighbouring counties, we should scarcely have expected so much difference in the mean rates of increase downwards. In this respect, Rosebridge agrees well with the average of results obtained elsewhere. Dukinfield far surpasses all other deep mines or wells, so far as our present records extend, in slowness of increase.

This implies one of two things, either that the strata of Dukinfield afford unusual facilities for the transmission of heat, or that the isothermal surfaces at still greater depths dip down in the vicinity of Dukinfield.

Mr. Hull has called attention to a circumstance which favours the first of these explanations, the steepness of inclination of the Dukinfield strata. He argues, with much appearance of probability, that beds of very various character (sandstone, shales, clays, and coal), alternating with each other, must offer more resistance to the transmission of heat across than parallel to their planes of bedding, as Mr. Hopkins has shown that every sudden change of material is equivalent to an increase of resistance; and it is obvious that highly inclined strata furnish a path by which heat can travel obliquely upwards without being interrupted by these breaches of continuity.

To this suggestion of Mr. Hull's it may be added that inclined strata furnish great facilities for the convection of heat by the flow of water along the planes of junction. It appears likely that surface water, by soaking downwards in this direction, may exercise an important influence in assimilating the temperature at great depths to that which prevails near the surface. Mr. Hull's own statement of his views is given in the foot-note below.*

* "Rosebridge Colliery occupies a position in the centre of a gently-sloping trough, where the beds are nearly horizontal; they are terminated both on the west and east by large parallel faults, which throw up the strata on either side. The colliery is placed in what is known as the 'deep belt'

"Dukinfield Colliery, on the other hand, is planted upon strata which are highly inclined. The beds of sandstone, shale, and coal rise and crop out to the eastward at angles varying from 30 to 35 degrees. Now, I think we may assume that strata consisting of sandstones, shales, clays, and coal, alternating with each other, are capable of conducting heat more rapidly along the planes of bedding than across them, different kinds of rock having, as Mr. Hopkins's experiments show, different conducting powers. If this be so, we have an evident reason for the dissimilar results in the case before us. Assuming a constant supply of heat from the interior of the earth, it could only escape, in the case of Rosebridge, across the planes of bedding, meeting in its progress upwards the resistance offered by strata of, in each case, varying conducting powers. On the other hand, in the case of Dukinfield, the internal heat could travel along the steeply-inclined strata themselves, and ultimately escape along the outcrop of the beds.

"I merely offer this as a suggestion explanatory of the results before us, and may be allowed to add that the strata at Monkwearmouth Colliery, the thermometrical observations at which correspond so closely with those obtained at Rosebridge, are also in a position not much removed from the horizontal, which is some evidence in corroboration of the views here offered." —*Proc. Roy. Soc.* Jan 27th, 1870.

Mr. McFarlane has been prevented from continuing his observations near Glasgow during the past year by the press of business incident to the removal from the old to the new college.

Mr. F. Amery, Druid House, Ashburton, Devon, has taken some observations with one of the Committee's thermometers in the shaft of a mine which had been unused for a year, and was nearly full of water. The shaft is 12 feet × 7 feet, and descends vertically for 350 feet, after which it slopes to the south at an angle of 50°, continuing to the depth of 620 feet. The water stood at 50 feet from the surface. Mr. Amery observed the temperature at every 50th foot of depth in the vertical portion, and found it to be 53° at all depths, except at 250 feet and 200 feet, where it was 53°·4 and 53°·2 respectively. A copper lode crosses the shaft at the depth of 250 feet, and it appears to be generally the case in the Cornwall and Devonshire mines, that copper lodes exhibit a high temperature, a circumstance which Professor Phillips explains by the conformation of the strata, which is such as to cause water from greater depths to make its way obliquely upwards by following the course of the copper lodes.

The nearly constant temperature observed from the surface to the bottom of the the shaft seems to indicate a large amount of convective circulation. In this respect small bores have a decided advantage.

Mr. G. A. Lebour has taken observations with one of our thermometers in several shafts and bores near Ridsdale, Northumberland, made for working coal and ironstone. Mr. Lebour does not report the temperatures observed, which he characterises as discrepant and utterly valueless, owing, he believes, to the numerous water-bearing beds which they cut through, and the very varying temperature of these waters. Having now, however, found a dry bore, he hopes to make a useful series of observations next winter.

One of the Committee's thermometers has recently been sent to Mr. John Donaldson, C.E., Calcutta, who has expressed his desire to aid in scientific observation, and, being now engaged in examining for coal and iron under government, is likely to render us effective service.

Shortly after the last meeting of the Association, the Secretary of this Committee addressed a letter to Professor Henry, Secretary of the Smithsonian Institution, U.S., requesting his co-operation in furthering the object which the Committee have in view, at the same time forwarding one of our protected thermometers.

In June of the present year, an answer was received from Professor Baird, Assistant Secretary in charge, to the effect that Professor Henry's ill-health during the present season had prevented his communicating to us the results of his labours in response to request.

The letter addressed to Professor Henry made special reference to an artesian well of extraordinary depth which was understood to be in course of sinking at St. Louis, and, at the same time, a letter was addressed, and a special thermometer sent to Mr. C. W. Atkeson, the superintendent of the work of boring at St. Louis. No reply has been received from Mr. Atkeson, who appears to have left St. Louis before the letter arrived; but letters have been received through the Smithsonian Institution from Dr. Charles W. Stevens, superintendent of the County Insane Asylum at St. Louis, this being the institution for whose uses the well was sunk, together with a very interesting newspaper cutting, consisting of Mr. Atkeson's report on the works. The boring of the well was commenced (at the bottom of a dug well 71½ feet deep) on the 31st of March, 1866, and was continued till the 9th of August, 1869, when the work was stopped at the enormous depth of 3,843½ feet, exceeding by more than one-half the depth of Dukinfield Colliery. The strata penetrated consisted in the aggregate of 63 feet of clay, 6 feet of coal, 380 feet of shales, 2,725 feet of limestone, and 620 feet of sandstone.

A cast iron tube of 11½ inches bore was first put down, reaching from the top and secured in the limestone at the bottom. This tube was then lined inside with a wooden tube, reducing the bore to 4½ inches. A 4½-inch drill was put down through this tube on the above-mentioned date. The bore was afterwards enlarged to 6 inches, and subsequently to 11½ inches to a depth of 131½ feet. A sheet-iron tube was then put down, extending from the top to this depth, and the

bore below was enlarged first to 6 and afterwards to 10 inches diameter, to the depth of 953 feet. A sheet-iron tube, 79 feet long, was then put down, which rests on the offset at the bottom of the 10-inch bore. The 4½-inch bore was then enlarged to 6 inches to the depth of 1,022 feet, and a wrought iron tube of 5 inches bore, weighing more than six tons, was introduced, reaching from the top and resting on the offset at the bottom of the 6-inch bore, thus securing the work to this depth, and reducing the bore to convenient size to work in. The 4½-inch bore has been continued to the depth of 3,843 feet 6 inches without further tubing.

At the depth of 3,029 feet the first observation of temperature was taken, and the reading of the thermometer was 107° F. This first observation is stated by Dr. Stevens to be specially worthy of confidence, as having been confirmed by several repetitions, or rather, to use Dr. Stevens's own words, "this was the maximum of several trials." It was taken, as well as those that followed it, by means of a registering thermometer (kind not mentioned); but in answer to our inquiries, Dr. Stevens states, upon the authority of the carpenter who attached the thermometer to the pole by which it was lowered, "that no means were taken to defend the bulb from pressure." In the absence of further information (and Mr. Atkeson himself has not yet spoken), we can place no reliance upon the temperature recorded, as the thermometer had to bear a pressure of three-fifths of a mile of water.

The temperatures registered at lower depths, the deepest being 800 feet lower, were all, strange to say, somewhat lower than this, a circumstance which is all the more remarkable because the pressure (which tends to make the reading higher) must have increased with the depth. At the bottom, or rather at 3,837 feet, being 6½ feet from the bottom, the temperature indicated was 105°. Either of these results, taken apart from the other and compared with the surface temperature, would give a result not improbable in itself. The mean temperature of the air at St. Louis appears to be about 53°, but it seems desirable to avoid publishing calculations till the data are better established.

Unfortunately, the apparatus which was employed in boring has all been removed, after the insertion of two wooden plugs, with an iron screw at the upper end of each, one at the offset at a depth of 1,022 feet, and the other at the offset at the depth of 953 feet, for the purpose of separating the fresh from the salt waters. These plugs were driven in with great force, and can only be withdrawn with the aid of a series of poles and other appliances, such as were used in the boring, which will be rather costly. The poles alone are estimated to cost $1,152, or about £200. If the plugs were withdrawn—and, according to Dr. Stevens, there is nothing but the expense to prevent—the whole well would be available for observation. The Committee will make every effort to prevent so rare an opportunity from being lost.

The Secretary has also been in correspondence with Messrs. Mather and Platt, of Salford Iron Works, respecting a boring at Moscow, for which they have furnished machinery, and which is to be carried to the depth of 3,000 feet. They refer to General Helmerson, of the Mining College, St. Petersburgh, as the best authority to whom application can be made for particulars of the Moscow boring as to temperature, &c. The Secretary has, accordingly, written to General Helmerson, endeavouring to interest him in the objects of the Committee, and offering to forward thermometers. No reply has yet been received.

An element which it is necessary to know, with a view to the correct reduction of our observations, but which in many instances it is difficult to obtain by direct observation, is the mean annual temperature of the ground at, or near, the surface. Instances frequently occur in which the temperature at the depth of 200, 300, or it may be 500 feet is accurately known, while the temperature in the superincumbent strata can only be guessed at. This is the case at the Kentish Town well, and partially at Rosebridge and Dukinfield Collieries.

It is very desirable that in connection with temperatures at great depths there should in each locality be an accurate observation at the depth of from 50 to 100 feet. At such depths in the solid ground before it has been disturbed by mining operations, one observation suffices to give a good approximation to the mean temperature of many years. At depths of two or three feet it is necessary to observe,

once a week or so, throughout the year, in order to get the mean temperature at that depth for that year; and this may differ by a considerable amount from the mean of a series of years.

In the Report of the Scottish Meteorological Society for the quarter ending December, 1862, there is a comparison of the mean temperature of the air with that of the soil at the depths of 3, 12, and 22 inches, at four stations, from observations extending over 5 years; and in the Journal of the same society for the quarter ending December, 1865, there is a comparison of the temperature of drained and undrained land from one year's observations, undertaken for this purpose, at two stations, and including also a comparison with the temperature of the year. The mean temperature of the air for each day, is, in these comparisons, assumed to be the simple arithmetical mean of the maximum and minimum as indicated by self-registering thermometers 4 feet from the ground. From these observations, it appears that the mean annual temperature of the soil was, in every case, rather above that of the air, and that the excess was greater for sand than for undrained clay, and was greater for drained land than for the same land undrained.

The greatest excess occurred in the case of the 22 inch thermometer at Nookton (Vale of Leven), where both surface and subsoil are sandy and dry. The five yearly means at this station were :—

Air, 46°·1; soil at 3 inches, 46°·3; at 12 inches, 47°·3; at 22 inches, 48°·0; giving an excess of 1°·9 for the temperature at the depth of 22 inches as compared with air.

The smallest excess, in the case of the 22 inch thermometers, observed for five years, was at Linton (East Lothian), where it amounted to 0°·7; but the observations on the effect of drainage gave for the year of observation an excess of only 0°·2 at the depth of 30 inches in light sandy, but undrained, soil under a rye-grass crop, at Otter House, near Loch Fyne, the corresponding excess for drained land of the same kind and in the immediate vicinity being 0°·9.

The mean temperature at the depth of 3 feet at Professor Forbes' three stations at Edinburgh, from five years' observations, gave an excess of 0°·55 above the mean temperature of the air at Edinburgh as determined by Mr. Adie's observations.

Observations on soil temperature in England are much needed, but the Greenwich observations give an excess of soil above air temperature falling within the limits above quoted, the excess at 3 French feet being 1°·7, while at 24 French feet it is reduced to 1°. The soil of which the Observatory Hill is composed, and in which the thermometers are sunk, is dry gravel, and the unusual circumstance of decrease of temperature downward observed in the comparison of the 3 feet and 24 feet thermometers, seems to indicate that the surface of the hill is warmer than the surrounding land.

In the present state of our knowledge, then, it appears that when the temperature of the earth has been observed at a depth of some hundreds of feet in any locality in Great Britain, and has not been accurately determined at a less depth, some knowledge of the rate of increase downwards may be obtained by assuming provisionally that the mean temperature of the surface is about a degree higher than the mean temperature of the air, supposing the latter to be known.

It is to be wished that the Meteorological Society, would, from the ample materials in their possession, publish a map of annual isothermals for Great Britain; and the objects of this Committee would be greatly furthered by an extensive series of soil temperature observations at the depth of about 3 feet.

The Committee are anxious to carry into effect Mr. Hull's proposal (quoted in their last Report) to bore down from the bottom of a deep mine; and as Rosebridge Colliery appears to be an eminently suitable locality for such an operation, the Secretary has consulted Mr. Bryham respecting its practicability and probable cost. Mr. Bryham's reply is, that there would be no difficulty in carrying out the proposal at Rosebridge, that to make preparations and bore 300 feet would, on a rough estimate, cost £150, and that the second 300 feet would probably cost about the same sum.

The Committee would earnestly appeal to the liberality of the Association to enable them to put this design in execution, and they would remark that the sooner it is carried out the more valuable the results obtained will be, as the mine

has been but recently opened to its present depth, and the influence of atmospheric temperature will every year become more sensible in the strata below.

At the conclusion of the report, Professor Bolzani (of Kazan) and Mr. C. W. Siemens, F.R.S., suggested the employment of certain forms of electro-thermometers, and pointed out the advantages which they considered would result from their employment.

We may mention that subsequently the General Committee passed a grant of £150 for the purpose of carrying out Mr. Hull's suggestion at Rosebridge Colliery.

On the Great Movements of the Atmosphere. By A. BUCHAN, F.R.S.E.—Mr. BUCHAN gave a succinct resumé of the principal results contained in his paper of Barometric Pressure recently printed in the *Phil. Trans. of the Royal Society of Edinburgh*, which has already been fully noticed in these pages. Under these circumstances, lengthened report of his excellent Liverpool address seems unnecessary.

On the Temperature of the Air at 5 ft., 22 ft., and 50 ft. above the Ground. By Mr. J. GLAISHER.--In the Report to the British Association for 1866 (the last of the Balloon Reports), the author maintained that the law of decrease of temperature with increase of elevation was variable throughout the day, and variable in different seasons of the year ; that at about sunset the temperature was nearly the same up to 2,000 feet ; and that at night (from the only two night ascents) the temperature of the air increased from the earth upwards. It was therefore evident that, instead of a few ascents being necessary only, a larger number were required than it was possible for him to make. Fortunately, in the second year of the balloon experiments, he planted at the Royal Observatory, Greenwich, a dry and wet bulb thermometer, at the height of 22 feet above the soil ; and since then readings have been taken daily of these instruments at the hours of 9 a.m., noon, 3 p.m., and 9 p.m. Sometimes readings at the higher point were above those at 4 feet from the ground ; but no reductions were made until after the observations had been made by M. Giffard's captive balloon, which proved that the decrease of temperature with increase of elevation had a diurnal range, and was different at different hours of the day ; the changes being greatest at about mid-day, and least at or about sunset (see Report for 1869), whilst sensible changes occurred within 30 feet of the earth. In consequence, the observations made at the height of 22 feet were reduced by taking the difference between the readings of the two thermometers, and affixing the sign *plus* (+) to that difference when the temperature was higher at the higher elevation ; and the sign *minus* (—) when *vice versâ*. All the observations made in the years 1867-70 were treated in this way. On taking the monthly means of these differences, it was found that the *mean* temperature of the air at 22 feet high was higher than at 4 feet. At all hours of the day and night, during the months of January, February, November, and December ; in the early afternoon and during the night in the months of March, April, August, September, and October ; and in the evening hours (5th to 7th), and during the night in May, June and July ; and that the results in one year agreed very closely with those in the same months in the other years. By selecting the greatest number with a + sign, and the greatest number with a — sign in each month, it was found that in the winter months the temperature at 22 feet high ranged from 2 to 3 or 4 degrees above, and from 1 to 2 degrees below, that at 4 feet, and in the summer months from 4 to 5 degrees above, to 4 or 5 degrees below, that at 4 feet high. The ratio of minus readings to plus readings was in January and February 1 to 5 in all hours. In March, April, August and September during the day one of equality. In May, June and July during the day hours the ratio was 3 to 2 ; in October 1 to 4 ; in November 1 to 7, and in December 1 to 10. At the hour of 9 p.m. throughout the year it was 1 to 7. Thus the minus sign preponderates; indicating low temperature above during the day hours in the months of May, June and July ; the minus and plus are about equal in number in the months of March, April, August and September ; and the plus sign preponderates, indicating greater warmth above, during the day and night in January, February, October, November and December, and during the night throughout the year. A second thermometer, properly protected from radiation,

was placed in the middle of the year 1869 at the height of 50 feet, and since then its readings have been regularly taken. The mean monthly temperatures of the air at 50 feet high were found to differ from those at 4 feet, as follows :—

	At 9h. a.m.	At Noon.	At 3h. p m.	At 9h. p.m.
1869, October	+0°·2	—0°·5	+0°·7	+1°·5
,, November	+0°·6	+0°·5	+0°·8	+1°·4
,, December	+0°·9	+0°·3	+0°·5	+0°·5
1870, January	+1°·1	+0°·3	+0°·7	+0°·9
,, February	+0°·1	—0°·3	+0°·3	+0°·5
,, March	—0°·3	—1°·8	—0°·7	+0°·7
,, April	—0°·9	—2°·2	—1°·7	+1°·4
,, May	—2°·4	—3°·6	—2°·8	+1°·1
,, June	—2°·4	—3°·8	—3°·1	+1°·1
,, July	—1°·8	—2°·9	—2°·8	+1°·1
,, August	—1°·7	—2°·7	—2°·0	+1°·7

Thus we have the unexpected result that the mean monthly temperature of the air at 22 feet and at 50 feet high is higher during the evening and night hours throughout the year than at the height of 4 feet, and also higher night and day during the winter months. By selecting those days with a sky covered by dense clouds, it was found that there was on such days no difference between the temperature at 4 feet, 22 feet, and 50 feet high. At the height of 50 feet, in the summer months, the temperature during the day was frequently 6 and 7 degrees lower than that at 4 feet, and at night 5 or 6 degrees higher.

In the discussion, Prof. Bolzani, of Kazan, said he considered the observations treated, and the conclusions drawn from them, important, and that they should be continued and extended in the way Mr. Glaisher indicated. He had himself been trying to make observations in balloons, having heard from Mr. Glaisher and other members that such observations made in the interior of the great continent would be of value. He obtained a grant from the Minister for Public Education, and had constructed instruments for observations of temperature and pressure of the atmosphere up to a height of 1,000 feet, with a captive balloon. The thermometer is on Mr. Siemens's principle, and is read on the ground by means of a galvanometer connected with the instrument, and attached to the balloon by a wire in the cable of the balloon. By using Wheatstone's balance, in a way also indicated by Mr. Siemens, he is able to get rid altogether of the influence of the intermediate strata. The instrument for pressure is new, and constructed on the same principle. As he was only able to perfect the arrangements before starting on his journey here, he had as yet no observations to lay before the Section, though he hoped to be able to produce some at the next meeting, when the construction of the instruments will be illustrated by diagrams. With regard to greater heights, he trusted also to be able to make some ascents at Kazan, as he hoped, with the help of some members of the British Association and with part of the money granted, to procure a balloon of larger size.

A Proposed Re-arrangement of the Registration Districts of England and Wales for the purpose of facilitating Scientific Enquiry. By ALFRED HAVILAND.—The author commenced his discourse by stating that the registration districts of England and Wales were formed for the general purposes of the Poor Law Administration, and therefore it could not be expected that they were planned with any view of assisting science ; they had, however, done so when in their present crude and artificial form, and it was generally believed among scientific men that if their boundaries were determined on a natural system, the advantages to meteorology, climatology, and other branches of science, would be incalculable, and the expense and confusion of constant alterations avoided. Messrs. Keith Johnston had lately been much engaged by him in the rectification and completion of the registration maps of England and Wales, for the purpose of insuring extreme accuracy in his basis map of the geographical distribution of disease in England and Wales. This had involved him in a considerable extra outlay, but through the recommendation of the Registrar-General, the Treasury, seeing the necessity of the

work, had expressed their approval of a grant being paid to Mr. Haviland for the extra expenses incurred. He urged that the artificial system adopted in defining the boundaries of the registration districts had been the cause of all this extra work and expense, and that it had nothing whatever to recommend its continuance; on the contrary, it was the fruitful source of repeated alterations, and would continue to be so whilst it was persevered in. On the other hand, the author showed that were a natural system substituted for the present one, and our country divided into districts regulated by its watershed and river system, we should then have in every district a focus of scientific enquiry, whether it be as to the rainfall, temperature, prevalence or strength of winds, agricultural statistics, the produce of our fields, our mines, or our rivers, or for the purpose of registering the occupations, the diseases or the deaths of the people. Moreover, such a system would form the best basis map for every future census, and being once established upon a well considered and natural plan, would do away with the necessity of those eternal alterations which are now year by year going on, to the utter confusion of the scientific student. In France the watershed system is adopted in defining and naming the departments, it is vastly superior to our own, and although its deficiencies are numerous, yet they will act as beacons to us. The author was well aware that such a revolution could not be accomplished under ten years, therefore he urged the necessity of commencing it at once. Should the natural system be adopted before 1881, it would be ready for the census of that year, by which time the Registrar-General will have completed two more decades of mortuary records under the present system, and these, with the one (1851-60) which Mr. Haviland had geographised, will form a most important foundation for all future enquiry. Mr. Haviland proposed that a committee should be formed to take the whole matter into consideration, and report thereon, first to the British Association, and then to Her Majesty's Government.

On a Scale for Computing Humidity, By Prof. J. D. EVERETT.—This was a description of the scale designed by Mr. Russell, of Sydney, and already noticed in these pages.

On Variation of Rainfall, with Elevation of the Gauge. By Mr. C. CHAMBERS.—It is well known that the quantities of rain received in gauges placed at different elevations above the ground diminish as the elevation of the gauge increases. Two distinct causes are suggested to explain this: (1) that damp air transferred by the agency of winds from a warm to a cold district finds the latter region colder, not in the upper strata of the atmosphere only, but also in the lower, and in cooling has its vapour condensed as well in the lower strata as in the higher. Consequently, a rain gauge placed at any given elevation will catch rain amounting to the sum of the condensations of the strata above it, and therefore the lower a gauge is placed the greater will be the quantity of rain it receives. The second cause suggested supposes the particles of vapour suspended in the air to be susceptible of electric induction, and, consequently, to be electrically polarized by induction from the ground, which is known by observation to differ in electrical tension at all times from the atmosphere above it. This polarization of the particles of vapour gives rise to mutual attractions between them, and to their successive coalescence forming rain drops, and the attractions being strongest near the ground, the coalescence will be there most rapid. Consequently, not only should more rain be caught by a gauge at a lower elevation than by one at a higher, but the rate of variation with height of the quantities received should be more rapid near the ground: and this is in accordance with observation. The second cause also serves to explain the greater fall of rain over forest-land than over similarly situated even ground; and also, in part, the greater fall in mountainous districts than over neighbouring plains.

On a new Electro-Magnetic Anemometer, and the Mode of Using it in Registering the Velocity and Pressure of the Wind. By Mr. J. J. HALL.—After describing the difficulties attending the use of the present forms of anemometrical apparatus, the author described the apparatus devised and exhibited by himself. The anemometer consists of two parts, viz., velocity apparatus and registering apparatus.

The first, a set of Robinson's hemispherical cups, communicate their motion downwards into a brass box, where it is reduced in angular velocity, and causes a contact disc or commutator, in which two platinum contact-pins are fixed equidistant from one another, to revolve in 1-10th of a mile. An insulated metallic lever, having a platinum working face, stands on either side of the disc, so that upon the completion of every 1-500th of a mile one or other of the contact-pins comes in contact with the two levers, thus uniting them and completing the circuit. The levers are raised a few degrees, and then fall back to their normal position ready to be taken up by the next pin, and so on. The recording apparatus consists of a train of wheels and pinions working in a frame or between two brass plates, the arbors of which project through a dial-plate whereon the circles and figures are engraved, and carry the hands. These wheels are driven by a weight attached to a line wound round a barrel, and a locking-pin disc—the pinion of which works in the first wheel—is released at every contact of the cup apparatus by an electro-magnet, which unlocks the pin-disc and allows the first hand to advance 1-500th of a mile on the graduated dial by a jump similar to the minute hand in remontoire clocks. By turning on a "strike-silent" stop, a hammer lever is brought into connexion with the escapement and strikes a bell at every contact. By this arrangement the observer has nothing to do but to notice the seconds hand of his watch or chronometer while he counts the number of times that the bell is struck, each of which corresponds to the 1-500th of a mile, and by a formula arranged and exhibited by Mr. Hall, who has also arranged a comprehensive series of tables for use with this instrument, the hourly velocity may be readily deduced. In noting velocities extending over long periods of time, the instrument is read in the same manner as the ordinary cup and dial anemometer, or as a gas-meter. By means of the formula before mentioned—although the unit of measurement by this instrument is 500ths—the observer may arrive at results as near the truth as if the instrument were capable of recording the 1,000th part of a mile, while the great advantage lies in the fact that the battery power is less called into action, from which we may infer its elemental duration will be considerably longer.

A paper by Mr. R. A. PEACOCK, on "*Changes of Climate.*" was next read. He expressed the opinion that these changes were due to rain and rivers, denudations, rising and sinkings of land, and the great range of temperature on the earth's surface. These would account for a future warm, and afterwards for a cold period, and for a glacial and cool period in the past. He contended that the future cold period would come on when the present land had been denuded to below high water, and will probably be aided by the natural sinkings of land, and especially by the upliftings of mountains, if such should recur. He added that the present gradual (or intermittent) rise of Northern Europe and Asia will assist to produce cold if it continues.

The Rev. R. B. BELCHER raised the question whether it is not possible to influence the weather by artificial means. He thought it was possible; and mentioned in support of his view the great hurricane or cyclone, and the immense wave which swept both the French and English coasts immediately after the explosion and petroleum fire in the Bordeaux harbour. He also stated that the explosion on the Mersey of the Lotty Sleigh was heard where he lived, a hundred miles from the scene of the explosion. It was followed by an immense black cloud and very heavy rain. Then, directly after the fighting commenced between the French and Prussians, the long drought which preceded it was broken up, and all wars were, for the most part carried on in rain and mud. He thought, therefore, rain could be produced by artificial means. The subject was not followed up by any other speakar.

SOLAR RADIATION.

To the Editor of the Meteorological Magazine.

SIR,—I send you the commencement of my observations with the three solar thermometers (F, G, H) with the air differently exhausted.

They are by Pastorelli, made with the greatest care, out of the same piece of glass, pointed together, and of one uniform size throughout. The bulbs are about five-sevenths of an inch in diameter, and, together with a small portion of the stem, are blackened by means of flame. I have to thank Mr. Pastorelli for his kindness and attention during their manufacture. The exhaustion of the air, as is always the case with these instruments, was conducted under the immediate superintendence of Mr. Pastorelli himself. They are constructed on the same principle as Negretti's patent now expired, and are very sensitive in their action. In the thermometer F, as given in the table, the vacuum is as perfect as can be accomplished with the air-pump. From G the air is only partly exhausted by heat. In H all the air is left, and I am glad to say that it has not been found necessary to chemically dry the air at all. They are placed on posts 4 feet high and the same distance apart, and with the bulbs all facing the E.S.E., in an open space.

Original Thermometers.			*Experimental Thermometers.*				
Date. 1870.	Pastorelli. A	Casella. B	Vacuum F	Air partly exhausted. G	Influence of partial exhaustion G—F	Not exhausted. H	Influence of non-exhaustion H—F
October 14 ...	...	...	82·0	80·8	— 1·2	79·0	— 3·0
,, ,, ...	..	...	86·5	82·5	— 4·0	81·8	— 4·7
,, ,, ...	..	..	89·0	84·0	— 5·0	83·3	— 5·7
,, ,, ...	...	...	90·0	84·4	— 5·6	84·0	— 6·0
,, ,, ..	..	.	95·0	86·5	— 8·5	86·5	— 8·5
,, ,, ...	...	...	100·0	92·5	— 7·5	91·5	— 8·5
,, ,, ...	...	...	110·0	100·0	—10·0	98·8	—11·2
,, ,, M	98·5	111·7	112·5	101·0	—11·5	99·7	—12·8
October 15 ...	...	..	87·0	79·4	— 7·6	86·2	— 0·8
,, ,, ..	...	...	93·0	84·7	— 8·3	87·5	— 5·5
,, ,, ...	...	...	104·0	95·0	— 9·0	93·5	—10·5
,, ,, ...	..	...	107·5	96·7	—10·8	95·3	—12·2
,, ,, M	97·2	111·0	108·3	98·2	—10·1	97·1	—11·2
October 17 ..	...	...	84·0	78·8	— 5·2	77·8	— 6·2
,, ,, ...	...	. .	96·5	89·0	— 7·5	87·8	— 8·7
,, ,, ...	...	...	99·5	90·8	— 8·7	89·5	—10·0
,, ,, M	94·2	107·7	104·6	95·3	— 9·3	94·0	—10·6
October 18 ...	...	.	93·8	85·0	— 8·8	83·0	—10·8
,, ,, ...	...	...	100·7	91·7	— 9·0	90·0	—10·7
,, ,, ...	...	...	104·0	93·7	—10·3	91·8	—12·2
,, ,, ...	.	...	105·5	95·0	—10·5	94·0	—11·5
,, ,, M	99·5	114·5	110·8	100·6	—10·2	99·5	—11·3
October 19 ...	...	...	82·4	79·3	— 3·1	78·4	— 4·0
,, ,, M	93·4	103·8	98·3	92·8	— 5·5	96·0	— 2·3
October 20 M	83·0	96·2	96·0	86·7	— 9·3	85·2	—10·8
,, 21 M	78·5	87·0	84·0	79·0	— 5·0	79·0	— 5·0
,, 22 M	77·2	82·8	81·0	78·0	— 3·0	77·5	— 3·5
,, 25 M	78·0	87·0	77·8	75·2	— 2·6	74·0	— 3·8

M indicates the maximum of the day.

It appears from the readings given in the table that the more perfect the exhaustion the higher the temperature attained; and that

imperfect exhaustion, as compared with all air, or no exhaustion, does not make a great deal of difference. I foresee a very important question must soon arise, viz., is the so-called vacuum thermometer the more correct test of "solar radiation," or the thermometer with all the air left in the jacket? I hope, however, as the experiments progress, light may be thrown on the whole matter.

Mr. Stow, in his letter to you, is much surprised at the large mean difference (15°·4) in August between Pastorelli's (A) and Casella's (B) thermometers; I am equally so, but to prove that the thermometer used was not a solitary exception, I will mention that for some time I have had another of Casella's instruments (C), which differs from (B) by not more than 3°.

The latter (C) has a remarkably good verification from Kew up to 92°, so I think we may reasonably infer that it is a good instrument throughout its scale.

I cannot help thinking that Mr. Stow labours under a delusion in supposing that large bulbs read lower, in all cases, than small ones. I have certainly not found it so; to give some instances:—

		Mean of October.
(A)	Thermometer blackened on bulb, half-inch diameter, and part of stem	90°·5
(E)	,, very slightly larger bulb, not blackened on stem	90°·8
(D)	,, still larger bulb ,, ,, ,,	92°·9
(F)	,, bulb $\frac{5}{7}$-inch, blackened on stem, averages 10° higher than thermometer (A).	

I find, also, that in the two Casella thermometers (B, C) before mentioned, that though both are blackened on the bulbs and stems, the one with the larger bulb (B) reads higher, though there is very little difference in the size. Mr. Stow also seems to lay considerable stress on the superior sensitiveness of small bulbs, but I should not imagine that would make much difference in the long run. Moreover, vacuum thermometers are so wonderfully sensitive to the slightest rays of sun or light. He further mentions that he cannot see what we should gain by using thermometers in vacuo to indicate the shade temperature for comparison with the sun, and also for a test of thermometer stands. Your space would certainly not permit, even if your inclination did, my entering into a long discussion on this matter, so suffice it to say for the present, that it looks as if we should have to compare the vacuum in shade with the vacuum in sun, or alter our thermometer stands so that they are unaffected by radiated light, *perhaps* then we might compare the ordinary maximum with the vacuum with more show of reason.

Mr. Stow further says, talking about thermometers in vacuo, "though very sensitive to the sun's rays, they are not very sensitive when used as ordinary thermometers." Permit me to say that I think if the same words had been applied to the ordinary maximum, there might have been a greater show of observation in them. To take an example. I have found the vacuum instrument so sensitive in my stand that merely moving it two inches lower caused a difference of

more than two degrees! So that in testing stands it is most important to have the vacuum thermometer *exactly* on a level with the ordinary maximum. Mr. Stow seems to lay a good deal of stress on testing stands with a black bulb thermometer *not* in vacuo, but I cannot think it could be nearly so effectively performed as by the other method—for instance, referring to some of my notes, I find that on the 20th September last, which will be a fair example I think, a bright and sunny day, the greatest difference in my stand between a blackened bulb not in vacuo and an ordinary thermometer was only 1°·5, but the difference between the vacuum thermometer in the stand and the other thermometer was 6°·5. It should be remembered, too, that the excess of my vacuum shade maximum over the ordinary shade (as given by me in your September number) amounted to nearly 11° on more than one occasion.—Your very truly, FRANCIS NUNES.

Heathfield Lodge, Chislehurst, Kent,
1st November, 1870.

P.S.—In accordance with your suggestion, I annex tabular particulars of my different thermometers.

Distinctive Letter.	Diameter of Bulb.	Blackening	Diam. of Jacket.	Maker.	Remarks.
	in.		in.		
A	0·5	On bulb & part of stem	2·0	Pastorelli.	
B	0·4	,, ,, ,,	2·5	Casella.	
C	0·35	,, ,, ,,	2·4	,,	
D	0·55	,, not on stem.	2·0	Pastorelli.	
E	0·53	,, ,, ,,	1·8	,,	
F	0·71	,, and on stem.	1·9	,,	Perfect vacuum.
G	0·71	,, ,, ,,	1·9	,,	Partial ,,
H	0·71	,, ,, ,,	1·9	,,	Not exhausted.
I	...	.....	...	...	.....
J	...	.....	..	..	.....

RAINFALL IN OCTOBER.

THE distribution of the fall of rain during the last month having been rather unusual, we supplement our usual table with a few other returns, some noticeable for their large amounts and others for the reverse. The station which heads the list is a new one, near Beddgelert, recently started by Major Mathew.

	in.		in.
XI. Snowdon, Pen-y-gwryd...	23·00	VIII. Bolton.....	11·54
X. Helvellyn, Birkside	22·50	IX. Willow Hall, Halifax ...	10·39
XI. Head of Clwyedog	22·00	V. Holne Vicarage, Dartmoor	10·34
X. Helvellyn, Wythburn ...	21·75		
XI. Llanwddyn	21·70	XVI. Dundee	3·29
X. Easedale	21·00	IV. Dunmow...	2·80
XI. Llanidloes	19·50	,, Diss.....	2·73
X. Mardale Green	19·00	XVII. Budgate, Nairn	2·02
IX. Malham Tarn	13·06	,, Auldearn ,, ...	1·70
,, Bucknall, Skipton	14·89		

DIFFERENCE BETWEEN READINGS OF MERCURIAL AND ANEROID BAROMETERS.

To the Editor of the Meteorological Magazine.

SIR,—During the atmospherical disturbances throughout the past month, I was particularly struck with the differences which existed between the readings of the mercurial and aneroid barometers; and on referring to the observations noted by me in the months of August and September, I observed the differences to be of a *reverse* notation and of equal range to those in October; it seemed to me, therefore, that these variations of the indication of pressures,(be it from any cause inherent in the instruments,) if they stood the test of future observations, might prove of some value in predicting coming changes, or the prolongation of either fine or stormy weather, and moreover would be of much utility to seamen.

With a view of attracting the notice of your readers to this subject, and possibly of inducing some of them to follow up the investigation, I send you an abstract from my register for the months of August, September, and October, 1870, taken daily at 9 a.m.

I will not occupy your valuable pages by pointing out each peculiarity of the differences of the simultaneous readings of both these instruments; it may suffice were I to notice prominently the high rate of the + differences in August, its gradual decrease to the 6th September, and the further fall preceding the stormy and rainy weather we experienced from and after that date. Again, from about the end of September the differences fluctuated, and decided — differences occurred from the 8th October, foretelling the advent of stormy weather and its prolongation.

There was another interesting coincidence: the greatest — differences occurred on the 24th and 25th October, the dates on which the brilliant aurora was visible; greater on the former date when its display was superior.

Before I close this communication, I consider it proper to say that my aneroid was set on the 12th June last to the corrected height (reduced to 32° F.) of my standard mercurial barometer, which was made by Negretti and Zambra.

My daily readings were according to this formula, only adding to them the quantities equivalent to the height of my instruments above sea level; no allowance was made for temperature to the observed reading of the aneroid.--Yours truly,

JOHN KNOTT.

Ilminster, November 3rd,

NOTE of explanation of abbreviations in the Abstract Registers :—

o	Overcast sky.	q	Squally.
f	Foggy.	qq	Stormy.
d	Drizzle.	Ci	Cirrus.
L	Lightning.	Cu	Cumulus.
g	Gloomy.	c	Clouds.
r	Rain.	b	Blue Sky.

Ilminster, Somerset, August, 1870

Date.	Reduced to 32° F., sea level		Diff. of Aneroid from Bar.	REMARKS ON WEATHER.
	Barom.	Aneroid		
1 ..	29·850	29·867	+·017	o, f, d ; Scotch mist all day ; L at 7 p.m.
2...	·919	·939	+·020	o, g, d ; do. do. ; r at 5 p.m.
3...	·880	·909	+·029	o, g, d ; g day with mild sunshine
4...	·781	·801	+·020	Very cloudy ; r at 2 p.m. ; d from 7 p.m. and during night.
5...	·734	·754	+·020	Do., d ; fine sunny day.
6...	·975	·995	+·020	Sunny day, light breeze ; q from 9 p.m. ; q r during night.
7...	·758	·791	+·033	Very cloudy ; mild sun during day.
8...	·924	·937	+·013	o morning ; wind S.W. ; from 9 a.m. wind S. ; hot day ; from 1 p.m. r.
9..	30·140	30·176	+·036	Warm sunny day ; wind veering from N.N.E. to N.N.W.
10...	·203	·229	+·026	o morning ; warm sunny day.
11...	·254	·287	+·033	o with very light cirrus ; very cloudy and sunny day ; wind veering W. to N.W.
12...	·284	·321	+·037	close warm morning ; hot day.
13...	·325	·365	+·040	o g morning ; very cloudy and hot day.
14...	·259	·297	+·038	Very cloudy and sunny all day.
15...	·118	·156	+·038	Do. do.
16...	·129	·160	+·031	Do. mild sunny day.
17...	·116	·140	+·024	Clear morning ; very cloudy and hot day.
18...	·032	·046	+·014	Very g morning ; hot day.
19..	29·940	29·944	+·004	Dark and light cumuli in morning ; b during day.
20...	30·129	30·138	+·009	cold clear morning ; light r at 10.30 a.m. ; strong wind in afternoon.
21...	·257	·269	+·012	Do., do., do. ; very cloudy and sunny day ; wind backing from N.W.
22...	·131	·170	+·039	Occasional light r during day, and heavy from 8 p.m., to midnight.
23...	29·917	29·919	+·002	Very cloudy all day ; wind unsteady from S.W. to W.N.W.
24...	·975	·987	+·012	Very cloudy ; light r at 11 a.m. ; cloudy and sunny afternoon.
25...	30·059	30·070	+·011	Fine sunny morning ; wind backed from N.N.W. to N.W.
26...	29·948	29·957	+·009	Very cloudy ; Ci intermingled with dark Cu ; sunny day.
27 ..	30·009	30·027	+·018	Mares' tails in morning ; very cloudy, and light r during day ; q r during night.
28...	29·587	29·600	+·013	Very cloudy day ; and light r during day with scud.
29...	·933	·937	+·004	Cloudy, sunshine, and high wind during day.
30 ..	30·229	30·234	+·005	Cloudy, with light wind during day.
31...	·331	·341	+·010	Gloomy, sunshine during day.
Mean..	30·036	30·057	+·021	

September, 1870.

Date.	Reduced to 32° F., sea level.		Diff. of Aneroid from Bar.	REMARKS ON WEATHER.
	Barom.	Aneroid		
1...	30·011	30·022	+·011	Very cloudy ; q all day and at night, with r.
2...	29·514	29·525	+·011	Do. ; mild sunshine during day ; r from 7 p.m. and at night.
3...	·606	·610	+·004	Sunny day, with high wind and very cloudy.
4...	30·030	30·045	+·015	Very cloudy and sunshine during day, and strong S.W. wind.
5...	29·696	29·706	+·010	0, r, and q ; from 5.45 to 9 a.m., scud ; again from 5 to 6 p.m. ; r at night.
6...	·520	·535	+·015	0 ; light r in morning ; hail storm at 2.50 p.m., followed by smart r.
7...	·365	·369	+·004	0 morning, with smart r ; b sky all day, with occasional showers.
8...	·813	·801	—·012	Mares' tails in morning ; very cloudy and fine during day ; r during night.
9...	·453	·444	—·009	Very cloudy ; sunshine and passing showers during day.
10...	·775	·766	—·009	Cloudy and b sky ; d, q ; high wind all day.
11...	30·200	30·210	+·010	Misty b sky, and cloudy during day ; heavy black C in afternoon.
12...	·201	·216	+·015	Very cloudy day : light r at 5.30 p.m.
13...	·107	·116	+·009	Do. and g all day, with occasional d.
14...	29·961	29·977	+·016	Do., do. during day ; do., do. ; sunny afternoon.
15...	30·299	30·309	+·010	r early morning ; 0, g, d, all day.
16...	·522	·550	+·028	0, g, all day.
17...	·508	·538	+·030	0, g, all day.
18...	·369	·404	+·035	0, f, morning ; very cloudy and occasional sun during day.
19...	·342	·377	+·035	0, f, morning ; cloudy and occasional sunshine during day.
20...	·348	·356	+·008	f ; cold ; ice in garden ; g, b during day ; sunny afternoon.
21...	·371	·378	+·007	b ; cold ; cloudy ; sunny during day ; warm.
22...	·351	·364	+·013	0, f ; g sunshine during day ; heavy dew at 6 p.m.
23...	·326	·334	+·008	g, b morning ; sunny all day.
24...	·305	·317	+·012	Heavy f ; sunny and hot during day.
25...	·377	·397	+·020	Do. f ; very cloudy, and sunshine during day.
26...	·224	·244	+·020	Fine sunny day, with lengthy Ci streaks N. to S.
27...	·266	·267	+·001	b and sunny all day.
28...	·343	·357	+·014	Do., do. in morning ; very cloudy and sunny day.
29...	·419	·432	+·013	Dense f in morning ; clear during day, and cloudy afternoon.
30...	·480	·498	+·018	0, g ; very damp morning ; very cloudy and damp forenoon, and sunny afternoon.
Mean..	30·103	30·115	+·012	

October, 1870.

Date.	Reduced to 32° F., sea level.		Diff. of Aneroid from Bar.	REMARKS ON WEATHER.
	Barom.	Aneroid		
1...	30·559	30·572	+·013	o, g morning ; b all day.
2...	·516	·538	+·022	f morning ; streaky Ci ; higher Ci moving fast E. to W. ; b all day.
3...	·510	·520	+·010	f morning ; b and sunshine during day.
4...	·548	·565	+·017	Dense f, street wet; dim sunshine latter part of day.
5 ..	·406	·420	+·014	Dense f, streets less wet ; do., do.
6...	·190	·200	+·010	g morn.; very cloudy Cu; mild sunshine during day.
7...	29·821	29·831	+·010	g ; heavy dew in morning ; high wind ; sun ; r from 1.25 p.m. ; q night.
8 ..	·245	·243	—·002	Sunny morning: sunshine in day ; passing showers in afternoon.
9...	·059	·042	—·017	Very cloudy ; passing showers during day, and little b sky.
10 ..	·481	·444	—·037	b ; frosty morning ; sunshine during day ; dark Cu in evening.
11...	·934	·892	—·042	b ; frosty morning ; very cloudy day ; after midnight q, r.
12...	·333	·316	—·017	o, q, r, morning ; q all day ; qq, r, at night.
13...	·545	·515	—·030	q ; sun morning ; very cloudy, q all day ; r from 3.30 to 4.30 p.m.
14...	30·047	30·032	—·015	r early morning ; very cloudy all day and cold.
15...	·008	29·992	—·016	fine, cold morning ; g sunshine all day ; o q night.
16...	29·410	·396	—·014	o, g, q, r, morning ; q ; much light r all day.
17...	·599	·573	—·026	Sunny morning, much b sky ; o, q ; light r all day.
18...	·907	·892	—·015	o morning ; q, r, forenoon; qq, r, scud in afternoon.
19...	·516	·505	—·011	Very cloudy morning ; temp. at 9 a.m. 56·1, at noon 45·0 ; hail storm.
20...	·595	·565	—·030	q, r, all day ; q, d, at night.
21...	·990	·975	—·015	Very cloudy, mild sunshine, and l during day.
22...	·886	·879	—·007	Very cloudy, and light r all day, with high wind.
23...	·017	28·990	—·027	Sunny morning ; sun ; very cloudy and light r during day.
24...	·098	29·052	—·046	qq, r, since midnight, and so nearly all day, with sun ; aurora at 7.30 p.m.
25...	·510	·467	—·043	o, r, morning ; very cloudy day, with d and sun; aurora N.E. at 8 p.m.
26...	·535	·507	—·028	o, g, d, morning ; very cloudy, occasional sun, and r during day ; r at night.
27 ..	·705	·671	—·034	o, d, morning; heavy r drops ; fine day ; q at night.
28...	·923	·897	—·026	q and fine morning ; sunny during day ; very cloudy evening.
29...	30·053	30·053	...	o, g, morning ; light r all day.
30...	·007	·002	—·005	Sunny morning ; sunny during midday ; from 6 p.m. r ; q, r at night.
31...	29·661	29·650	—·011	o, q, r, morning; q to 1 p.m.; sunny 1 to 3 p.m. ; o afternoon.
Mean..	29·794	29·780	—·014	

OCTOBER, 1870.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	3·68	+ 1·09	·46	30	23	69·7	2	31·0	11	1	4
II.		Maidstone (Linton Park)	3·89	+ ·79	·98	23	20	70·0	2, 3	30·0	11	3	...
,,		Selborne (The Wakes)	4·85	+ ·64	·67	16	16	66·2	2	25·8	11	3	4
III.		Hitchen	3·47	+ ·92	·64	30	18	63·0	8	33·0	9§	0	...
,,		Banbury	3·83	+ 1·40	·67	30	18	67·0	2	30·0	11	1	...
IV.		Bury St. Edmunds (Culford)	3·03	+ ·32	·43	20	19	65·0	3	29·0	10	1	5
V.		Bridport	3·52	— ·51	·57	22	19	68·0	2	29·0	11	1	...
,,		Barnstaple	8·50	+ 4·38	·78	19	23	69·0	5	36·0	11	0	...
,,		Bodmin	7·60	+ 2·28	·96	19	21	69·0	2	38·0	31	0	...
VI.		Cirencester	4·54	+ 1·05	·98	16	14	...	...	...	...	...	...
,,		Shiffnal (Haughton Hall)	4·47	+ 2·23	·91	7	21	61·0	1, 2*	30·0	11	1	...
,,		Tenbury (Orleton)	4·87	+ 1·64	·92	7	21	68·7	1	28·3	11	2	6
VII.		Leicester (Wigston)	3·48	+ ·78	·56	31	17	71·0	1, 2	30·0	10	1	...
,,		Boston	3·30	+ 1·18	·62	7	21	65·0	1	33·9	11	0	2
,,		Grimsby (Killingholme)	6·60	..	1·70	7	23	60·0	1, 4	32·0	26	0	...
,,		Derby	4·91	+ 2·07	1·14	7	23	68·0	2	31 0	11	1	...
VIII.		Manchester	8·36	+ 4·55	1·12	8	25	69·0	1	31·0	11	2	2
IX.		York	6·10	+ 3·58	1·25	8	21	63·0	1	31·5	11	1	...
,,		Skipton (Arncliffe)	13·38	+ 6·72	1·85	12	21	67·0	5	25·0	11	6	...
X.		North Shields	66·	— 1[illegible]	08·	2	21	2·67	02	0·88	21	0	0
,,		Borrowdale (Seathwaite)	23·00	+ 6·68	...	..	...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Town Hall)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	8·52	+ 3·33	1·99	16	13	66·0	1	26·5	10	1	...
,,		Rhayader (Cefnfaes)	12·23	+ 6·63	1·20	12	22	63·0	...	27·0	...	3	...
,,		Llandudno	7·04	+ 3·08	·97	12	23	69·6	1, 2	41·2	11	..	...
XII.	SCOTLAND.	Dumfries	5·72	+ ·80	1·07	12	17	...	...	..	...	..	...
,,		Hawick (Silverbut Hall)	3·35	...	·59	12	20	...	...	...	...	...	...
XIV.		Ayr (Auchendrane House)	4·99	+ ·04	·83	7	20	68·0	2	30·0	10	1	9
XV.		Castle Toward	6·21	+ ·46	·89	18	18	67·0	2	31·0	10	1	3
XVI.		Leven (Nookton)	3·24	— ·51	1·11	12	13	60·0	1†	30·0	15	1	19
,,		Stirling (Deanston)	5·31	+ ·40	.87	18	19	60·0	1	27·5	11	5	13
,,		Logierait	4·08	...	·81	23	12	...	...	...	...	...	...
XVII.		Ballater	4·75	...	1·12	18	15	70·0	2	26·0	16	7	..
,,		Aberdeen	3·09	...	·66	18	16	58·0	1	33·2	15	0	18
XVIII		Inverness (Culloden)	2·32	...	·62	17	15	62·2	1	35·7	14	0	19
,,		Portree	7·37	— 3·41	1·01	16	22	...	...	..	...	...	...
,,		Loch Broom	5·20	...	·80	17	20	...	...	...	...	...	...
XIX.		Helmsdale	2·98	...	...	...	...	...	...	...	...	...	...
,,		Sandwick	3·17	— 1·75	·59	17	21	62·3	1	35·4	27	0	16
XX.	IRELAND.	Cork	6·70	...	1·15	11	14	...	...	...	...	...	...
,,		Waterford	5·74	+ 1·34	1·20	15	23	63·0	4	32·0	11	..	...
,,		Killaloe	9·91	+ 4·89	2·12	15	22	69·0	2	27·0	11	2	...
XXI.		Portarlington	6·54	+ 1·41	·91	16	30	65·0	1	30·5	10	...	...
,,		Monkstown	6·53	+ 2·61	1·52	8	17	...	...	...	...	...	...
XXII.		Galway	9·69	...	1·22	30	22	70·0	1	32·0	9, 31	...	...
,,		Bunninadden (Doo Castle)	9·92	...	1·75	11	22	59·0	6	24·0	11	2	...
XXIII		Bawnboy (Owendoon)	...	...	..	...	...	...	...	...	..	..	..
,,		Waringstown	6·81	...	·94	7	19	69·0	4	30·0	9	3	9
,,		Strabane (Leckpatrick)	9·74	..	1·24	12	23	65·0	2, 3	24·0	6	5	20

*And 8. †And 2, 3. §And 10, 11.

+ Shows that the fall was above the average ; —that it was below it.

METEOROLOGICAL NOTES ON OCTOBER.

ABBREVIATIONS.—Bar for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail, S for Snow.

[NOTE.—All remarks on the Auroræ of the 24th and 25th have been omitted in these pages; most of those in which special and probably useful details were given, have been printed on pages 155-157.]

ENGLAND.

CAMDEN TOWN.—Gale on 12th and 13th; solar halo at 4 p.m. on 18th.

LINTON PARK.—First week dry and fine, the remainder changeable, with frequent R. T on the 8th and 9th; bar. very changeable at that time. No very high winds or severe frosts during the month, and less fog than usual in October.

SELBORNE.—The bar. was higher on the 1st than it has been for four months, and on the 24th it was lower than it has been since December, 1868; the wind excessively high during a considerable part of the month, and principally from the S.W.; frequent fog during the first week.

HITCHEN.—1st, the highest bar., and 9th, the lowest bar. I ever saw; heavy T S on 26th to the N.W.

BANBURY.—High winds on 12th, 19th, and 22nd.

CULFORD.—Frequent fogs during the first week; high winds on the 12th, 13th, 15th, and 16th; T and hailstorm on 27th; mean temp., 49°·0.

BRIDPORT.—The first week fine, but wet and rough weather during the remainder of the month; heavy gales on 16th and 19th; some swallows seen on the 30th. L on 23rd.

SHIFFNAL.—Fog or mist each morning for the first week, when a most acceptable soaking R (·91) came, on the 7th, which was repeated, with only four exceptions, daily throughout the month, but 8 in. still due to make up the average for the year; too late to benefit the after-marth, but swedes, apparently dead, sprout again; mangolds a fine crop, also potatoes. Common B fly appears, after some years' interval; 8th, aphides cleared off by the fine R of yesterday; 11th, tender plants partially killed; 17th, black Hamburgh grapes and also figs ripen fully on the open wall; 27th, Spanish chesnuts ripen their fruit; 31st, dahlias and other half hardy plants still exist, slightly cut.

ORLETON.—Very cloudy and misty mornings and bright afternoons till the 7th, when the long drought broke up with a heavy fall of R (·92), and the remainder of the month was stormy and wet; bar. very high on the 1st, and afterwards very low, especially on the 23rd; violent winds on 12th, 13th, 17th, 18th, and 24th; temp. of the month about 1° below the average.

DERBY.—The drought which prevailed the whole year up to this month has ended, and we record an excess of rainfall for October (nearly double the mean). On Thursday, the 27th, this neighbourhood was visited by a fierce T S accompanied by an amount of H, which remained till the next day.

MANCHESTER.—H on 9th and 17th; we have had an enormous rainfall this month, more than double the average.

ARNCLIFFE.—11th, a very large halo round the moon, followed on the 12th by storms of wind and R. The heaviest fall of R in the last three weeks of the month I have ever registered (13·38 in.).

WALES.

HAVERFORDWEST.—The fine weather broke up on the 5th; heavy fogs, ending in R, fearful storms of wind and R all through the month, especially on the 11th, 16th, and 21st. General character of the month, stormy, wet, and mild. Nearly all the R fell during the night, consequently this month did not fall short of its usual number of fine days.

CEFNFAES.—The month has been rather remarkable. First week dry, and fine pleasant weather; afterwards, continuance of R and often violent gales of wind (chiefly N.W.); on the night of the 12th the wind was very strong, and much damage ensued in this district.

LLANDUDNO.—H showers and L on 9th; H on 17th and 26th; heavy T on 27th.

SCOTLAND.

DUMFRIES.—The first week very fine, during the rest of the month much R; S on the hills on 9th.

SILVERBUT HALL.—Dense fog on the first seven mornings, with prodigious numbers of winged ants darkening the atmosphere in the twilight; slight frost on the night of the 10th; the heavy rains have kept the Teviot running full to the brim, and great numbers of salmon are now ascending to spawn.

AUCHENDRANE.—With a bar. pressure below the October mean, there has been a low mean temp., and small amount of cloud and evaporation; but the bar. range, much above the October mean, was attended by heavy R and by winds, principally equatorial, of a force also above the mean. There were gales on the 8th and 12th from N. points, and on 18th from S.; in the early part of the month there were fogs and calm heavy dews, and in the latter part of the month, auroræ, heavy rains, swollen rivers, and boisterous weather.

CASTLE TOWARD.—The fine weather of last month continued until the 11th of this; it has since been stormy and cold, with much R. Bar. very unsteady; it stood at 29·66 at 9 a.m. on 22nd, and at 28·64 at 9 a.m. on 23rd; gales on the 8th and 18th.

DEANSTON.—Till the 15th, only ·88 of R fell of the 5·31 in. that fell in the month, but it was generally dull and foggy, with some night frosts; storm of wind on the 13th; very wet after the 15th.

LOGIERAIT.—Severe easterly gales from the 12th to the 19th; the month closed fine.

BALLATER.—A good deal of R fell up to the 24th, after which the weather continued dry to the end of the month; sharp frosts have occurred on several nights, but the mean temp. has been comparatively mild throughout.

ABERDEEN.—The month was notable chiefly for unsteady bar. and the great bar. range, which, since 1856, has been exceeded only in February, 1860, and December, 1869; Deeside hills covered with S on 11th.

PORTREE.—From the 8th, the weather was cold, and very squally, the high ground generally covered with S; bar. fell 1·25 during the night of 22nd.

LOCHBROOM.—The fine weather which commenced at the middle of last month continued till the 8th, since which we have had a continuance of rough broken weather, but, on the whole, it has been one of the earliest and best harvests of this century.

SANDWICK.—October has given us a continuance of the fine weather of this remarkably fine season. It has been drier than the mean, and the wind less, but rather colder; heavy gales on 16th, 17th, and 18th.

IRELAND.

KILLALOE.—This (9·91) was the greatest fall at Killaloe in any month during the last 25 years, the next to it was in 1848 (9·80), but of that, 4·04 fell in one day; the fall (2·12) of the 15th began at 3 p.m.

MONKSTOWN.—The fall (1·52) of the 8th was the greatest in 24 hours since 5th of January, 1867, =1·64.

DOO CASTLE. Continually wet since the 6th; great floods in this locality; potatoe digging delayed fully three weeks.

LECKPATRICK.—First week fine, thence constant R and storm; gale of 12th nearly as destructive as that of the 9th of September; rainfall about double the average, the total fall being the largest since the gauge was started; number of frosty nights (20) unprecedented.

THE COMING WINTER.

To the Editor of the Meteorological Magazine.

SIR,—According to a law which, since 1771 (the year when reliable thermometrical observations were commenced), has *always* proved

correct, the coming winter must be remarkably severe, that is, the mean temperature must be very considerably below the average.

Whenever we have had meteorological phenomena similar to those to which the above-mentioned law refers, the mean temperature of a period of three consecutive months of the four comprising the succeeding winter (reckoning from December to March inclusive), has *always* been more than two degrees below the average of 99 years, and *eleven* times in twelve the mean has been more than three degrees below that average.

I do not wish to encroach unnecessarily on your valuable space, but if any of your readers would like to see the law and the proofs of its accuracy, I shall be most happy to furnish them in another letter. A law which (as applied to the last hundred years) has *never* failed, may perhaps be acceptable to some of them.—I am, &c.,

GEORGE D. BRUMHAM.

Barnsbury, November 8th, 1870.

METEOR OF SEPTEMBER 7TH.

To the Editor of the Meteorological Magazine.

SIR,—I had often wished to have the pleasure of seeing a meteor, and last night at 8.17 my wish was gratified. At the time mentioned above, a very dense cloud concealed the moon; in the west were some beautifully-shaped clouds, from which I observed two or three flashes of lightning. It was from these clouds that a brilliant meteor *plunged*. I know of no better expression to convey the idea of its motion; slowly at first, like a ball from a Roman candle, increasing in rapidity and in size, brilliancy and splendour, falling at an angle of about 45°; it was lost behind some clouds in the horizon immediately below the planet Saturn. It seemed to make its first appearance in the meridian line parallel with Saturn, and disappear as I have just said, under that planet.—Yours truly,

C. MALDEN.

St. Lawrence Rectory, Ventnor, I.W., Sept. 8th, 1870.

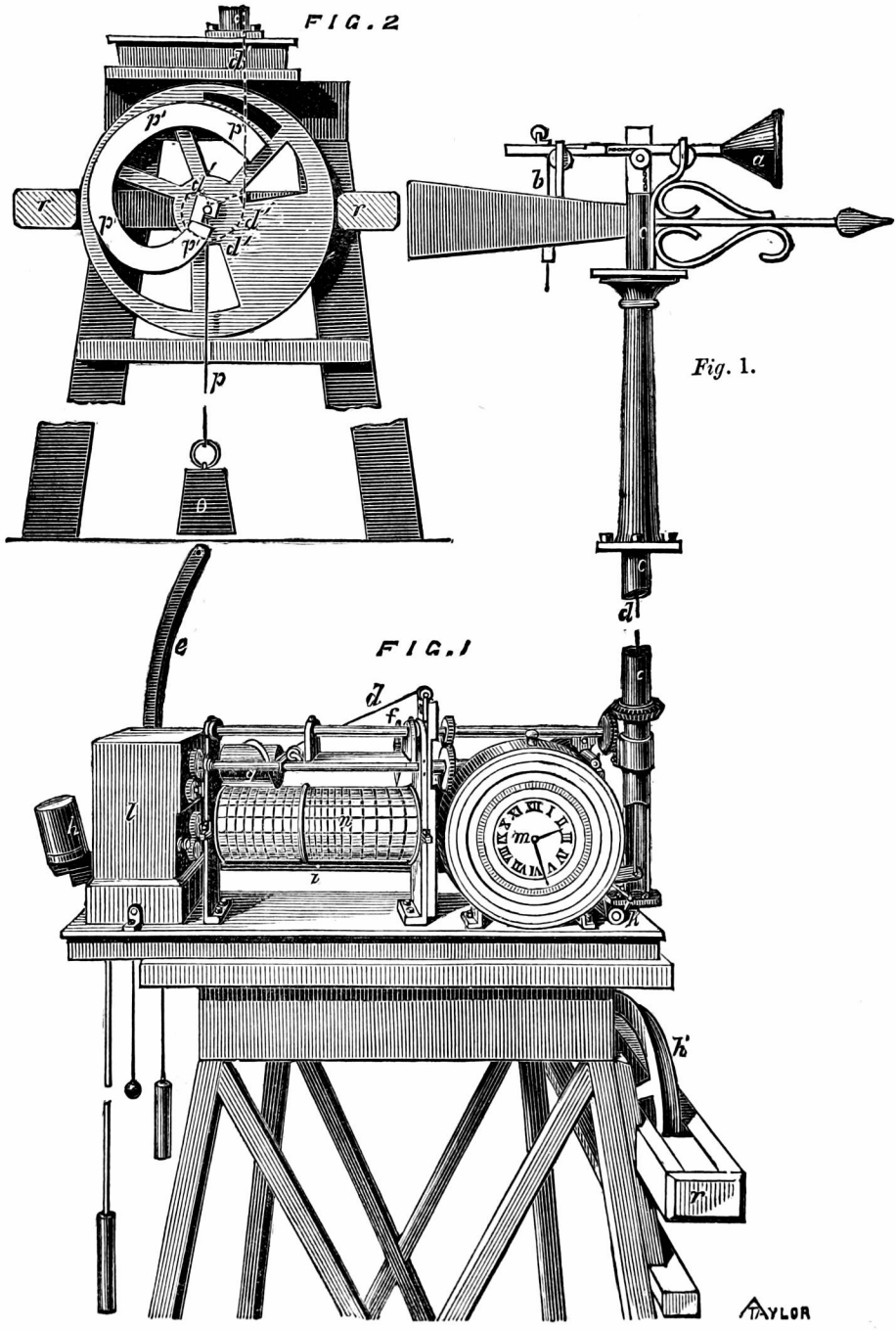
[We regret that the above was unavoidably omitted last month.—ED.]

SEA FOG.

To the Editor of the Meteorological Magazine.

SIR,—On Wednesday, September 28th, I witnessed a phenomenon which I think is not common. A sea fog prevailed all day, and in the afternoon the sun shining on the fog produced a bow similar to a rainbow, but almost if not quite colourless; it continued for about an hour. The air was not when I first saw it quite saturated here (dry 55°, wet 54°·5 at 3 p.m.), but on the higher grounds moisture was thickly deposited on the hair and clothes. The air is generally saturated most of the day during a sea fog here, whatever Dr. Allnatt may assert to the contrary.—I am, Sir, your obedient servant,

F. W. STOW.



CATOR'S ANEMOMETER, WITH SPIRAL ARRANGEMENT.